

Practical Classroom Research by Teachers

CLASSROOM EXPERIMENTATION
TO IMPROVE TEACHING



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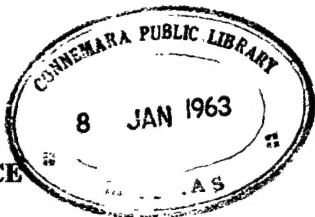


NEW DELHI, INDIA
1962

Price : Inland Rs. 2.20 nP.
 Foreign 5 sh. 2 d. 80 Cents.



***We Dedicate This Book
to the
Classroom Teachers of India
whose
Competence, Initiative and Resourcefulness
So Largely Determine the Quality
of the Schools***



PREFACE

Vast changes are taking place in India. The way her people earn their livings, communicate with one another, travel about, and interpret their physical and social surroundings are being modified at a rapid rate. The various five year plans are largely designed to facilitate these changes. In his new and dynamic culture, the Indian citizen tries to hold fast to what is fine and valid from his past, and, at the same time, to learn many new ideas, habits, attitudes and values. He must learn quickly in order to keep up with the fast progressing world.

In any country that undertakes to modernize and industrialize itself within a short period, all social institutions are subjected to many stresses and strains. This is no less true of India's schools than it is of her other social and economic institutions. If the schools cannot gear themselves to serve India's emerging needs, they will cease to have influence and the social usefulness of teachers will be greatly reduced. Respect for them will lessen. The recognition and support any nation gives its social institutions, including its schools, depends ultimately on the degree to which each makes its contribution to national development.

For the schools to change and improve so that they can influence, strengthen and serve the new India, the people who are responsible for what goes on in the schools must change and improve. Improvements in schools come from improvements in school people,—in their ways of thinking, in their approaches to the solution of their problems, in their development of the physical, mental and spiritual habits and values that are needed to accomplish their professional tasks. There is no escaping this fact. Great new schemes to improve Indian education will stay on paper only unless school people develop the will and the skill to implement the schemes. In the final analysis, most of the changing and improving must be by classroom teachers. It is they alone who teach the pupils,—the future citizens of India.

This raises a fundamental question : What is the best way to bring about changes in school teachers? The most popular method seems to be to tell them what to do, to give them

orders, and then to inspect, admonish, threaten, and scold them to assure that they are doing what they are told to do. The authors of this book had much experience with this method, at both ends. They have lost the faith they once had in it. They have developed increasing faith, however, in the desirable changes and improvements that occur in teachers when they are encouraged to experiment,—thoughtfully, systematically and with careful evaluation. This short book is written to encourage and help the experimental teacher. We hope that his number will increase for we believe this will be to the everlasting benefit of Indian education.

1st February, 1962

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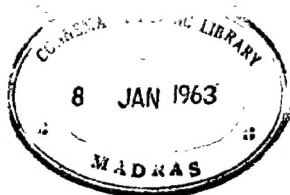


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CHAPTER I ABOUT THIS BOOK

This book is written primarily for classroom teachers in elementary and secondary schools. In the last analysis it is what the teacher does in the classroom that determines whether or not a school is a good one. Many people such as headmasters, inspectors and educationists can give teachers help and guidance. It is the teachers, however, who do the actual job of teaching. It is they who work directly with the pupils to improve their knowledge, skills and attitudes.

Even though this book is written for classroom teachers, it is likely to appeal only to those who frequently become dissatisfied with their own teaching and who sincerely want to do better. Such teachers question their methods and work to improve them. We believe that many teachers are like this. Most of those we have talked to and worked with either have ideas they would like to try out to make their teaching better and more effective or they are willing to try some one else's ideas.

The teacher who we believe will benefit most from this book not only wants to do better but has a preference for *working things out for himself*. He does not need someone to tell him exactly what to do. He is a creative, resourceful, imaginative and independent teacher. The book will make less appeal to teachers who, although they want to do better, must have someone else tell them what they should do.

The Teacher as a Decision Maker

Teachers are constantly taking and implementing decisions in the course of their teaching. By "implementing" we mean that after having taken a decision a teacher uses whatever knowledge and skill he has to carry it out. Here is an illustration :

A teacher of arithmetic in a primary class wants his pupils to improve their ability to do long division problems. He realizes that this requires practice and that practice takes time and time is precious. He decides that classroom time can be saved if the pupils practise doing long division problems at home. Having made this decision he assigns his pupils ten long division problems as homework.

If teaching is to improve, the decisions teachers take must become better decisions and teachers must also learn more effective ways of implementing their better decisions. The decisions and the implementation must become better in the sense that they lead to a finer education for boys and girls. In the example about long division the teacher might have been wiser if he had postponed assigning the

ten long division problems for homework until he had spent one or two more class periods demonstrating to his pupils how to do long division and encouraging them to ask questions about the process. In all kinds of teaching, the better the decisions a teacher takes as to what to do, and the greater his skill in implementing these decisions, the better he will teach.

Why are Certain Decisions Taken ?

Back of each decision a teacher takes is some reason for it. At least we have found it true that when teachers are asked why they took a certain decision and taught as they did, they are usually able to give some explanation. Many teachers, of course, require a little time to think about it.

The reasons leading to teachers' decisions, the reasons that are given to explain why they do *this* rather than *that* are of different kinds. Sometimes there is not much of a decision in the sense of making a choice among alternatives. What is done results from habit. The teacher gives the classroom situation he is dealing with little thought but decides to do what he has done again and again before. If he is asked "Why did you decide to introduce children to fractions by cutting up an apple?" he will answer, "That is the way I've always done it."

A decision to do the same thing each time a particular situation is faced,—doing what has become habitual,—is all right if the teaching habits result in a good education for children. As has been said, this must be the criterion used to judge the worth of all the decisions taken by school people. One difficulty with decisions that are explained as habitual is that habits, by their very nature, are not apt to be examined continuously to determine whether or not they bring about desirable results.

Another kind of explanation many teachers give for taking and implementing a particular teaching decision is in the form of citing some authority. A teacher might say he used the additive method for teaching subtraction because the lecturer in his Basic Training College said he should. Another teacher might explain his decision to emphasize craft work by saying "crafts were recommended in the syllabus prescribed by the Department of Education", or "The headmaster said I should." Another kind of authority influencing many school decisions is the pressure from some group. For example, production of saleable craft work is emphasized in a school because the management wants income from it. Celebrations of certain religious festivals are not conducted in another school because some powerful group in the locality is against such celebrations.

Explaining a decision by referring to some authority or to the will of some group means that the teacher, in a sense, avoids responsibility for what he has done or he should do to educate children properly.

If his decision turns out to be a poor one it is not his fault but the headmaster or the inspector or the Department or the pressure group that was wrong. The authors of this book believe that too great a willingness to cite some authority as a reason for the teacher doing certain things, with the inevitable result that the teacher does not take personal responsibility for what he has done, leads to a poor education for boys and girls. Teachers who lean too heavily upon authority, and are not inclined to think things out for themselves, are probably not inclined to encourage their pupils to do much independent thinking. Future citizens of a democracy must be taught to think for themselves. Training in thinking, reasoning and decision making is especially important in a young democracy like ours in India.

A fourth explanation a few select teachers give for the decisions they take and the way they implement these decisions, is in the form of reference to facts or evidence. A teacher might say, for example, in explaining his decision to have pupils practice long division as a homework assignment, "I explained and demonstrated long division in the class for five days until no single pupil had any further questions. Furthermore, every question I asked about long division was correctly answered. For this reason I decided to assign some long division homework problems to find out whether or not having the clear ideas about long division (the pupils seemed to have in class) would enable them to work some difficult problems on their own."

It is evident from this teacher's answer that he did not base his decision to assign homework problems on old teaching habits, or on the recommendation of the headmaster or anybody else. Instead, he used his own judgment which in turn was based upon evidence. He had evidence that the pupils understood long division, that they could answer his questions about it, and that they had no further questions of their own.

The authors of this book have great faith in the improvements that will come about in teaching if more and more teachers based more and more of their decisions upon facts and evidence which they have collected, sifted and verified. Some of the chapters in this book are descriptions of ways and means teachers can use for getting evidence and getting better evidence as a basis for their decisions and actions. The teacher who does research, who experiments to improve his teaching, is dedicated to evidence. He tries to solve his problems scientifically. He is an educational researcher. He conducts his research to improve his own practice. This kind of research is often called Action Research.

Two Kinds of Educational Research

Educational research, as the reader knows, has been conducted for a long time in the hope that the publication of the results would improve educational practice. Until quite recently it was generally believed that the only people who were qualified to conduct research

were the highly trained professional investigators who worked in colleges or research bureaus or state departments of education. The authors of this book believe that this point of view towards educational research is limited. We believe that the method of science as applied to educational problems will only make its greatest contribution to the improvement of education when hundreds of thousands of teachers, headmasters, inspectors and other school "practitioners" go about their decision-taking more scientifically. This means that they do all within their power to get facts, to get evidence, before they take a decision. Once having taken the decision they get additional facts and evidence to find out whether or not it resulted in the consequences desired.

We want to emphasize that this book is written to help teachers experiment or do research to *improve their own teaching*. The research is not to be done for its own sake. The teacher who says, "I don't have any time to do research. My classes are too big," is probably the very one who might better conduct some research to find out how he can teach large classes better. His research would not interfere with his teaching. It would improve his teaching. If he did not anticipate that his research would improve his teaching he should not start on it.

What This Book Includes

In the following chapters and in the hope that they will be of assistance to classroom teachers who want to experiment, who want to be somewhat more scientific in the way they deal with their practical classroom problems, the authors develop a number of different ideas. In the next chapter, Chapter II, they comment on the source for practical classroom problems. What causes them to arise? In Chapters III and IV they illustrate how two different groups of teachers, one using a traditional common sense approach, and the other, a more scientific experimental approach might deal with the same classroom problem. Chapters V and VI analyze the method of research or experimentation as applied to teaching problems and explain and illustrate each aspect of the process. Chapter VII is a discussion of the importance of evidence for anyone who tries to improve his teaching by experimenting. This chapter will also help teachers decide whether or not their evidence is dependable. Following Chapter VII are three chapters on getting different kinds of evidence; evidence of achievement in the various school subjects; evidence about attitudes and values; and evidence about actual, overt behaviour. Chapter XI describes how evidence can be summarized and interpreted so that conclusions can be more readily drawn from it. The book concludes with a chapter (XII) written for people like headmasters or inspectors who often want to help teachers experiment by providing them with some of the necessary resources.

We have tried to write the book so that it can almost be used as a manual by teachers who want to experiment better. We have tried

to use many classroom illustrations. The table of contents is made as complete as possible. Because we believe that learning must be an active process we hope that the teacher who reads will react to what he has read by making note in the margins of teaching experiences that are similar to those dealt with in the book. He can make a note when his own personal experience supports the points made by the authors. He can write down objections and criticisms when he feels like it. We urge the reader to be as active as possible, constantly checking what we have said by examining his own personal experience with classrooms and the teaching of boys and girls.

The authors will feel amply rewarded, and this book will have served its purpose if it helps many classroom teachers and school administrators to regard research and experimentation as worthwhile and to start solving some of their practical problems by using research methods. By doing so they will be making a significant contribution to the advancement of their own educational thinking and practice. As larger and larger numbers of teachers use scientific methods to improve their teaching, great contributions will be made to the betterment of education throughout India.

CHAPTER II

WHAT IS A TEACHING PROBLEM?

The classroom life of school teachers, particularly the conscientious and creative ones, rarely runs smoothly. Teaching for them is not a routine, habit ridden activity. If it is, the pupils suffer.

Classroom Problems Result in Teachers' decisions

An alert teacher, however, uses his mind, his judgment, his imagination. The decisions he takes as to what to do are determined by the particular situations that have developed in his class. Some examples of decisions that grow out of practical classroom problems are given below :

1. A teacher notes that his pupils seem to have become bored by arithmetic drill on the multiplication tables. He decides to try to increase their interest by having all of them take part in a mental arithmetic contest.
2. The pupils in a teacher's English class seem to be having particular difficulty spelling words with the "ie" and the "ei" combination when there are no pronunciation clues. He decides to try to locate some helpful mnemonic device and have his pupils memorize and use it.
3. A teacher's pupils who must learn about soil conservation are on vacation during the monsoon season. He decides to provide a visual demonstration of erosion by using a sand table and water hose.
4. A teacher finds that a 9th class students' council appointed by him does not work well. He decides to try having the council elected by the students themselves, to encourage the council to work out an agenda on its own initiative, and to attend council meetings himself only when he is asked to do so.

The decision taken by the teacher in each of these illustrations is taken with a purpose. The purpose is to achieve certain teaching aims that he has in mind. The teacher in illustration number one, for example, wants his pupils to learn the multiplication tables. He realizes that this will not happen unless the boys and girls have some interest in what they are doing. He notes that they seem to be bored. This leads him to decide to try to do something to reduce the boredom. What he decides to do is not the only thing he might have done. He could have decided to scold them for being inattentive. He might have concluded that boredom is inevitable when boys and girls are learning the multiplication tables and nothing can be done about it.

This teacher, however, because of his background, and his analysis of the teaching-learning situation that dissatisfied him, decided he would try a mental arithmetic multiplication contest.

In the second illustration, the English teacher had, as one of his aims, teaching boys and girls to spell correctly words with the "ie" or "ei" combination. This he had tried to do but when he got back some spelling papers this evidence told him that his aim had not been achieved. At this point, he made a decision as to what to do. His decision was again a choice among several possibilities. He could have given the pupils a few of these words every night for home work and insisted that they learn to spell them correctly. He might have done what one teacher we know did and instructed the pupils to put the dot between the two letters and put a loop in both of them so no one could tell whether the "e" or "i" comes first. This teacher, however, decided to search for and have his pupils learn a mnemonic device to enable them to spell correctly most of the words in the "ie" and "ei" list. The point again is that he took a decision and did something in order to achieve one of his teaching aims.

In the third illustration, the one having to do with soil conservation, the teacher was especially ingenious and creative. He might have decided just to lecture to his pupils about the relation between running water and soil erosion. He might have decided only to have them read about this topic in the textbook and be satisfied if they could answer correctly the questions he asked them afterwards. He, however, decided he did not want to use only words to teach these important concepts, but he wanted his pupils to have some visual, firsthand experiences. He had learned that the use of carefully selected teaching aids often led to better pupil learning. The fact that the children were not in school during the rainy period meant that he could not take them on a school journey and thus use natural events. It was necessary for him to contrive something. Consequently, he decided to build a sand table and, using water running from a small hose, demonstrate the effect of running water upon soil displacement.

In the fourth illustration the teacher analysed his experience with the students' council. His analysis led him to suspect that since he had chosen the students' council its members might not really represent the whole class. He further suspected that the members did not work together harmoniously and with the confidence of the class, and that his presence in every council meeting probably inhibited free and frank discussions because he represented authority. He, therefore, decided that the council should be elected, that it should work out its own agenda, and that he should not attend the meetings unless his presence was requested.

The point in all of these illustrations is that the teacher, noting some indication that his teaching aims were not being achieved, took a decision to do something about this situation. It is the disparity or gap between the teacher's intention, his aspiration, his teaching

aim, and the knowledge or skills or attitudes actually demonstrated by the pupils, that creates the teaching problem. Some of these problems are quite readily dealt with. Frequently, a teacher has already learned what to do under the circumstances. May be he has learned to do several things that have been quite successful. His decision then requires little more than selecting from among various techniques and procedures the one he thinks will be most appropriate in the situation out of which the problem arises.

The Four Central Instructional Questions

In chapters III and IV we will describe what two groups of teachers did when what they had already learned to do proved to be unsuccessful and it was necessary to search for and experiment with something new. This is where the research process really starts, with the decision that something new and better must be worked out and tried. The remainder of this chapter, however, is devoted to illustrating the kinds of problems many alert teachers face in their day to day teaching. These problems have been organized under four basic questions which every teacher must try to answer and about which he must take decisions in the light of his answers. The better his decisions and answers, the better his teaching.

What Should be My Teaching Aims ?

The first question is: "What should my teaching aims be? What kind of changes am I trying to bring about in my pupils? In what way should my pupils be different after having spent a year in my class?" This question has to do with the purposes of teaching, with the teacher's aims or objectives. Whatever a teacher does in his classroom is supposedly done because he believes it will help boys and girls learn what they ought to learn. Quite often the questions a teacher must answer that have to do with teaching aims or purposes are dealt with in a general way in the required syllabus. Most syllabuses, however, do little more than describe the content which the teacher is expected to cover.

Here are some of the more specific questions having to do with aims of teaching that teachers must answer and take decisions about in the course of their day to day teaching :

1. What kinds of practical arithmetic problems should my fourth class pupils be able to deal with satisfactorily?
2. How many different difficult Hindi words should I try to teach my pupils to spell each month? What should be the source of these words?
3. What general ideas about kitchen gardening should I try to teach my 7th class? What specific gardening skills should I teach them?
4. What important dates in Indian History should my pupils commit to memory?

5. What should my pupils in general Science know about the process of combustion at the end of the 9th class ?
6. What skills and habits should my pupils develop through a programme of cleanliness at the end of the junior Basic stage ?
7. What social skills and qualities of democratic leadership should my pupils develop at the end of the senior Basic stage ?
8. What specific kinds of "know-how" and attitudes should my pupils develop in respect to weaving before joining a multi-purpose school ?

How Can I Motivate My Pupils ?

The second important question every teacher must try to answer and decide what to do about goes like this : "What can I do to make my teaching aims seem important and deserving of hard work by my pupils ? What incentives can I use to speed up learning ?" This question, of course, has to do with pupil motivation. Much of the superficial learning in school and many of the disciplinary problems are a consequence of teachers paying too little attention to motivation. When pupils have little interest in what they learn they forget it very fast. Some educationists have insisted that tremendous sums of money are wasted by teaching pupils lessons in which they are not interested and which they forget at once. Basic education is a reform movement of great significance in part because it recognizes the importance of pupil motivations. This is made clear in the principle of Basic Education that whatever is taught to boys and girls in school should be taught in close relationship to their physical and social environment or the craft they are learning.

Some of the specific "motivation" questions that teachers must try to answer and then take decisions to do something about are as follows :

1. What can I do to help my pupils appreciate the importance of correct pronunciation ?
2. How can the important facts of Indian history be more closely related to my pupils' social and physical environment ?
3. How can interest be developed in applying to daily life the principles of general science that I teach the 9th class.
4. What can be done to interest pupils in reading good literature ?
5. How can the skills acquired by children in a craft class be carried over to the solution of the practical problems they face ?

6. What should be done to help pupils appreciate the importance for their daily living of the health habits and attitudes learnt in the school.

What Should Be the Learning Activities?

The third important question that teachers must take decisions about has to do with learning activities. Learning activities is the general name for all of the many things teachers ask their pupils to do in order to make their learning effective. The question might be phrased in this way: "What can I ask my pupils to do that will best enable them to learn each lesson I try to teach them. In a particular case would it be best to have them listen to me talk, or read a book, or plan and take a school journey, or work in the school garden, or watch a picture, or take part in a group discussion?" This is a question to which relatively little attention is paid in a typical syllabus. The syllabus usually describes the course content to be covered, but does not provide the teacher with much help in deciding which ones among many different activities will most efficiently lead to the attainment of his teaching aims.

Good answers to questions about learning activities are exceedingly important. If the only learning activities a teacher knows about and uses result in the pupils spending all of their time listening to the teacher talk and reading books and answering the teacher's questions, the pupils' school learning will be limited and frequently sterile. Indian history, for example, should be taught so that pupils can use it in understanding and doing something about modern Indian problems. This requires that the teacher plans some activities that give pupils practice in doing just this. If all they do in history classes is to memorize facts and dates and names, one of the important aims in teaching history is lost sight of.

We are indicating below some of the explicit and practical questions that teachers must try to answer and take good decisions about in this broad area of learning activities, instructional materials, and methods:

1. I want my 10th class pupils to form the habit of keeping up with current events. What is the best kind of activity I can get them to engage in to achieve this purpose?
2. What kinds of learning activities will help my 8th class boys to have a better appreciation of other communities?
3. I want my pupils in biology to understand the process of plant growth from a seed. Is there any way that this process can be presented to them visually?
4. If 9th class pupils are to learn to spell correctly in letters that they write, is it best to teach them spelling by dictating words to them?

5. I want my classroom to look clean and beautiful. What can I ask my pupils to do that will involve them in this activity?
6. As a teacher I want my pupils to develop general reading ability. What use can I make of the school library in this connection? What can I ask the pupils to do that will develop their interest in reading?
7. I want to teach my class about the national flags of various countries. What should I do that will make the pupils themselves see the importance of this knowledge?

How Can I Find out if my Pupils Have Learned?

The fourth and final question that every classroom teacher must deal with might be worded in this way: "What techniques or procedures can I use to find out whether or not what I have tried to teach my pupils has been learned?" This question has to do with evaluation, with assessment, with testing, and it, too, is a question that is rarely dealt with in the syllabus. It is generally known that day by day testing results in better learning and the day by day tests a teacher uses are generally developed by him. It is known, too, that pupils in all classes tend to learn best what they think they will be tested on. If the tests are of poor quality whatever the pupil learns in order to do well in these tests will probably be of poor quality.

We are giving below some of the specific questions having to do with testing and evaluation that might arise in the course of day to day teaching:

1. I would like my pupils to think carefully about social events. How can I test them to find out whether they have learned to do so?
2. How can I best find out whether or not my pupils can spell words correctly under circumstances where they will be writing outside school?
3. Is there a standardized test that might let me know how well my pupils do in arithmetic in comparison with other pupils of their age?
4. How can I measure whether or not my attempt to teach my pupils democratic attitudes has been successful?
5. How can I find out whether or not my pupils have developed interest in general reading?
6. Is there any way of finding out that certain desirable social skills develop through the celebration of festivals in the schools or through pupils' self-government activities?
7. How can I determine whether or not pupils who are clever in craft work are comparably clever in school subjects?

Conclusion

In this chapter we have attempted to show that whether teachers are aware of it or not, they are constantly taking decisions and engaging in actions in the light of these decisions. The decisions are taken when a teacher gets some indication that his instructional aims have not been achieved, that his pupils have not learned what he has tried to teach them. Under these circumstances he decides to do something in order that the aim will be achieved. All the decisions the teacher takes in this connection are based upon the way he answers questions having to do with teaching aims, with the motivation of learning, with instructional activities, materials and methods, and with testing or evaluation.

In the next two chapters we try to show how two different groups of teachers, faced with the same classroom difficulty, went about taking decisions as to how to deal with this problem in quite different ways. One of the groups was relatively undisciplined, subjective and opinionated. The other was more disciplined, more objective, and tried to get some evidence before it decided what needed to be done. The first group used "common sense." The second group tried research.

CHAPTER III

HOW DO TEACHERS USUALLY DEAL WITH CLASSROOM PROBLEMS?

In this chapter we describe the way a group of high school teachers might deal with a practical problem. The problem arises because of the gap between the teachers' expectations regarding the honesty and dependability of pupils and the pupils' actual behaviour. These teachers went about trying to improve this situation by what might be called "common sense" methods. In the next chapter we describe how more systematic and research minded teachers might deal with the same difficult and unsatisfactory situation.

The difference between the "common sense" and the research minded way of trying to solve classroom problems is only relative but it is important. The common sense, casual and subjective method of defining and diagnosing a problem, making practical decisions as to what to do about it, carrying out the decisions, and appraising their results, differs from a research or experimental approach in the discipline and degree of care exercised throughout the problem solving process. It is possible for teachers to progress, by stages, from the casual "common sense" method of problem solving, that results in problem solution only by chance, to a more rigorous, scientific experimental method which continues until the problem is actually taken care of.

Problem Solving : The Method of Common Sense

The teachers who used the customary common sense approach were all teaching history in a Higher Secondary School. They were called together by the headmaster to consider student indiscipline. The conversation at the first meeting went something like this :

- : I think we ought to do something about the fact that pupils in this school are not dependable. At least four students of class IX last year were known to have copied in examinations. At least I am quite sure they did.
- : You are right. Many of them do not get their assignments in, on time either. When the papers do come in, they are not neat and well written. The pupils are just irresponsible. Many of them tell a lie when they give reasons for their absence or for handing in assignments late.

The conversation continued in this vein for some time. Three or four of the teachers were responsible for most of the talk. They were noticeably upset by some of the things their pupils did. Their comments sometimes revealed as much about them as about their pupils. There seemed to be general agreement in the group that the

pupils were lacking in dependability and had not developed certain other character traits that several of the teachers considered important. The conversation resumed :

- : If we gave more emphasis in our history teaching to the biographies of great Indians,—men and women who are known to be honest and dependable and trustworthy—our pupils might realize how important these traits are and try to develop them.
- : I think so, too. Take Gandhiji, for example. If we could show the pupils how Gandhiji was honest and dependable from his childhood by narrating his experiences in the schools where he studied it should inspire our pupils. For example, when he was studying in the 1st class, the Education Inspector dictated five English words of which one word was "kettle". Gandhiji could not spell that word correctly. He paid no attention to his teacher's suggestion to make it right by copying from the neighbour's notebook. Gandhiji reports that he did not learn to copy in spite of the wrong persuasion of the teacher, yet his respect for the teacher was not minimised.
- : We could emphasise the lives of other great Indians like Yudhishtir, Harish Chandra, Swami Dayanand and Ishwar Chandra Vidyasagar, all of whom were known for their honesty, dependability, truthfulness and fair dealings.
- : If we were to emphasise the biographies of great Indians whom everyone admires and the children were to realize how important good character is, I'm sure they would act differently.

These and similar comments made it clear that several of the teachers believed that stressing episodes from the biographies of famous Indians in the history classes would improve the character of the pupils. A kind of hypothesis or prediction was implied : "If we put more emphasis on the biographies of famous Indians of exemplary character, the character of the pupils will improve."

The conversation continued :

- : I think we are in agreement about the emphasis on biography of highly respected Indians. In addition to the strictly historical materials and scholarly biographies we might try to find some biographical novels and maybe a few good motion pictures that would bring out the traits of dependability and honesty in famous Indians.
- : That sounds like a good idea. And in my lectures, whenever I see an opportunity I'll talk about specific episodes in the lives of some great Indians to try to make the importance of dependability and honesty more vivid.

——: We must be sure to meet again next April and take some time to try to find out whether or not this emphasis on biography has had good results.

The final remark indicates that at least one of the teachers considered the values claimed for emphasis on the biographical method to be hypothetical rather than assured. He suggested that the consequences of this emphasis be examined at the end of the year. No one else commented on this suggestion.

Now let us assume that the biographies of famous Indian historic or mythological personages were stressed by these teachers, each in his own way and in various degrees, throughout a school year. Eight months after the meeting at which the decision was taken to do so there was another meeting of the same teachers. This was at the very end of the school year. One of the teachers said:

——: We have talked with one another several times this year about our emphasis on the biographies of famous Indians in our classes. Does anyone know whether or not this has had a good effect? Have the pupils become any more honest or dependable?

——: I am not sure. The pupils in my class did seem to be more interested when we talked about biography.

——: I do not know whether it has made any difference or not. My pupils seemed interested, too, but I cannot remember any improvement in their dependability when it came to handing in papers or preparing for examinations.

The conversation continued for a while. There seemed to be a general impression that the emphasis on biography had worked fairly well. The headmaster then summed things up:

——: Well, let us try this method again. I think there is everything to gain and nothing to lose. Maybe we can persuade the librarian to buy more good historical novels. We might try, too, to make a little more use of motion pictures. Maybe the National Institute of Audio-Visual Education would help us.

These discussions, decisions, and actions illustrate the way a great many teachers deal with practical, classroom instructional problems. Feelings are expressed about certain difficulties, suggestions for overcoming them are made, vaguely defined actions are taken, and subjective impressions used to evaluate them. The teacher in the illustration did, however, give at least some attention to most of the questions that a group using the research or experimental approach would consider. Their method of dealing with these questions, however, was subjective and casual and based on impressions rather than objective evidence. This is indicated in the following paragraphs

each of which has as a heading an important aspect of problem solving.

Defining the Problem : No very specific problem was ever identified by the group. The headmaster and the teachers talked about a large problem area,—“character education.” They were worried because their standards for dependability, conscientiousness, honesty, and general moral behaviour were not being met by the pupils. No real attempt was made to delimit this broad problem area. No focus was ever achieved. Terms like “dependability” and “honesty” were not defined, although they are quite ambiguous. Many opinions were expressed about cheating and similar behaviour, but no one suggested actually finding out how much cheating took place, by which pupils, and under what circumstances. No one seemed to be interested in or aware of the importance of finding out how frequently the pupils cheated or were lacking in ability at the beginning of the year. Without this it would not be possible to determine whether or not improvement in character resulted from emphasis on the biographical method.

Analysing the Problem : Very slight attention was given to the diagnosis of the problem. *Why* do the pupils cheat? *Why* do they lie? *Why* do they hand in their assignments late? A careful diagnosis of a classroom difficulty is essential before the teacher can come to a wise conclusion as to what to do about it. Just as a medical doctor must carefully diagnose an illness before prescribing medicine or other treatment so must a teacher diagnose before taking remedial steps. These teachers, as has been noted, did not try to diagnose their problem but seemed to take for granted that a major reason for the indiscipline, or at least a reason they could do something about, had to do with their pupils lack of familiarity with episodes from the biographies of famous Indians of fine character.

Hypothesizing : The term ‘hypothesis’ as used in the kind of practical research we are talking about is a prediction that certain desirable consequences will follow if a particular line of action is taken. In the illustrative example the action taken was the placing of greater emphasis by the teachers on the biographies of famous and revered Indians. The predicted desirable consequence of placing greater emphasis on biographical episodes was general improvement in the dependability, truthfulness and general honesty of the pupils. No hypothesis was consciously formulated by these teachers. They only implied one and it was vague and general. No consideration was given to alternative actions that might represent even better ways of improving pupil character. No one expressed any familiarity with attempts that had been made elsewhere to teach history in such a way that the value and behaviour of boys and girls would be changed. There was no clear description of what specifically was to be done by way of giving more emphasis to biographies.

The implied hypothesis apparently grew out of the teachers' belief that pupils who learn about famous Indians will tend to emulate them. This belief is undoubtedly an instance of a more comprehensive theory the teachers accepted about the relation between knowledge and behaviour. The relation of the specific action proposal in the hypothesis to the more complex system of beliefs and values on which it is based was not discussed at all.

Designing a Test of the Hypothesis: The members of the group agreed to place greater emphasis on biographical episodes in their teaching. This, in a sense, was the group's conception of an "experiment" to test its hypothesis. It was a casual, off-hand experiment. There was little discussion of what the various teachers meant by "emphasis on the biographical method." There was no attempt to control this emphasis by deciding in advance how much of it would consist of reading or lecturing or looking at motion pictures. There was no agreement on the biographies of even the well known Indian persons that were to be stressed. Each teacher was on his own. At the end of the year no one really knew what changes in teaching had been introduced. It was all very casual and vague.

Obtaining Evidence: No one suggested that it might be well to try to determine the extent to which the pupils actually were dishonest or otherwise lacking in dependability. At the beginning of the school year, when the decision was taken to emphasize the biographical method, one teacher said: "We must be sure to take some time next April to find out whether or not this emphasis on biography has had good results." There was no discussion of how the group might reach this judgment. Any judgment regarding improvement requires some evidence about a troublesome situation at the beginning and end of a period of time. To know whether or not fertilizer improves wheat yield we must know how many maunds of wheat were grown on an acre before and after the fertilizer was applied. Similarly, to know whether or not emphasis upon the biography of famous Indians improves pupil dependability, dependability must be measured before and after the emphasis. There was, in general, not much awareness of the need for objective evidence to determine whether or not the actions taken led to any improvement in the situation. No one called attention to any techniques that might be employed to find out whether or not honesty and dependability or character in general had been improved. Reliance was placed entirely on casual recollection and subjective impressions.

Generalizing: At the end of the year the teachers devoted some time to taking a look back at what had been done and what the consequences seemed to be. Some teachers had one opinion, and some another. Apparently there was agreement that the plan had worked rather well. This generalization led to the decision that the emphasis on biographies should be tried again during the following year.

Conclusion

The way this headmaster and these teachers tried to do something about a problem that concerned them was not unusual. They did what many practical school people do when they take action to try to improve a practical situation. We would like to re-emphasize that these teachers did however pay at least casual attention to the various aspects of a problem solving process. They had a problem. They talked about its extent (problem definition). They made conjectures which implied some belief about causation (diagnosis). They implied a prediction that the pupils would do better if the biographical method were stressed (hypothesizing). They decided to try it (experimentation). They spent a few minutes discussing the consequences (evaluation and generalizing). The difference between what they did and what a more research oriented group of teachers might do as illustrated in the following chapter.

HOW TEACHERS CAN BE MORE SCIENTIFIC?

In the last chapter we wrote about the way a typical group of Higher Secondary School history teachers might go about trying to improve the honesty and dependability of their pupils. They were quite casual as they dealt with this problem, which was not well defined or diagnosed. Their search for solutions was far from exhaustive. Their decision regarding how to deal with the problem was not based either upon penetrating thinking or evidence. Their judgment about the success of their scheme was most subjective.

In this chapter we describe how a group of teachers in another Secondary School in America actually went about dealing with a similar problem.¹ These people had had more experience in scientific problem solving. They knew something about the experimental or research approach to dealing with classroom difficulties.

Defining the Problem: This group of teachers, as we have said, was also concerned about the character of their pupils. At a meeting at the beginning of the year there was quite a bit of talk about honesty, dependability, and other character traits. Many of the teachers expressed dissatisfaction with their pupils' attitudes and values. Some examples were cited. Several teachers, however, realized that the group was talking about a very broad problem area, not about a specific, focussed, instructional problem they could do something about. This conviction was expressed and generally agreed to after considerable discussion. Consequently, and for the purposes of the study, character was defined as including these traits; determination, honesty, persistence, leadership, and the disposition to work hard. These traits had been mentioned most frequently by pupils when they listed the outstanding characteristics of men and women who had made significant contributions to the history of their country.

These teachers also realized that they needed more than subjective estimates of the degree to which their pupils had good characters. Consequently they agreed to use, as a measure of character, the reputation each pupil had with his classmates. The method of getting judgments from each pupil about the character of his classmates involved having each pupil write down on a piece of paper the names of the three of his classmates who seemed best to exemplify each trait. A particular pupil's "character" score was the total number of times he was named by everyone in his class. It turned out that the typical pupil was named about 12 times in a class of thirty. The maximum number of times any pupil might be named was 150.

1. The remainder of this chapter is a modified report of what was done by a group of American High School Teachers. See Corey, Stephen M., *Action Research to Improve School Practices*, Chapter V.

These judgments, which research people would call "socio-metric" judgments, were obtained at the beginning and end of the school year and gave a measure of each pupil's "character" so far as reputation with his classmates was concerned, before and after the experiment. This made it possible to make a more precise estimate of the effect upon character of whatever actions the teachers took to improve it.

The attempt these teachers made to define their problem still left it a broad one. They realized that the reputation pupils had with their classmates was not the only indication of character. What boys and girls think of one another is important, but the judgments of adults are important too, as are self-judgments. It was realized also that the five traits used as a basis for getting the classmates' judgments of one another did not include all aspects of character. Recognition of these limitations in their problem definitions, however, did not create undue anxiety. The teachers realized that they were defining an important problem more carefully than they had before. Their attempts to get some actual evidence of their pupils' character and to limit, at least somewhat, the problem they wanted to work on were in sharp contrast with what was done by the history teachers described in Chapter III. The procedures of the second group represented progress in the direction of research.

Analysing the Problem : Even these more research minded teachers did little to try to get at the reasons for the indiscipline of their pupils. They spent a long time citing instances of indiscipline but very little time looking into the reasons for it. They were little if any better than the "common sense" group in this regard. This neglect represented a grave deficiency in their experimentation. A poor problem diagnosis is almost fatal to any real problem solution. As is indicated later on in this chapter, the emphasis on biography in history classes brought about no noticeable improvement in the character of the pupils. So far as accomplishing that purpose was concerned, the time invested by the teachers relating biographical episodes was not well spent. This may have been due *almost entirely* to a faulty diagnosis which resulted in a failure to identify the real reasons for pupil indiscipline of the sort that troubled the teachers. As was said in Chapter III, an attempted remedy for a bad situation based upon careless or superficial problem diagnosis will probably not be a successful remedy. If it is to a degree successful, this will be largely by chance.

Hypothesizing : These teachers were somewhat critical and painstaking as they "hypothesized" or predicted what might be the consequences should they take certain actions. They hypothesized consciously and explicitly. Almost from the beginning their attitude towards the proposed emphasis on biography in their teaching history was that it had promise, certainly, but that its effectiveness was not

assured. It must be put to an experimental test. In their hypothesizing the teachers predicted the following, after long discussion :

1. A rather close relationship will exist between scores on tests measuring information pupils have learned about famous historical persons and the extent to which these same historical persons are admired by pupils. This hypothesis meant that the teachers were not certain that learning episodes from biographies would lead to more admiration of the persons written about. At least the teachers decided to try to find out if there were a relationship between the amount that was known about national heroes and admiration for them.
2. The degree of admiration for well known historical personages will be increased as a result of classroom emphasis upon episodes from their biographies for one year.
3. A relationship will exist between the degree to which a pupil admires historical persons and the reputation the pupil has among his classmates for exemplifying the five selected character traits.

All of these predictions were related to the teachers' decision to emphasize biography in the classes. What these teachers did as they hypothesized in their research was far from perfect. The hypotheses leave much to be desired if examined from the point of view of the skilled educational researcher. "A measurable degree of relationship" is not a very exact prediction. The teachers had come to realize, however, that an experiment at least involved predictions. This was quite a step forward in the direction of better problem solving.

The decision to emphasize biographies was taken without much search for other possible remedies for the disciplinary situation. The teachers had little interest in finding out what others had done in connection with the same problem. They had little desire to become familiar with the literature of research and speculation about character education. Several studies were called to their attention by a consultant-supervisor working with them but they paid only courteous attention. Another weakness in these teachers' hypothesizing was that they made no conscious attempt to relate their action hypotheses to any theory of learning or character development.

Despite these limitations, this second group of teachers, in their attack on the problem, especially in the formulation of hypotheses, did much better than the "common sense" group. And doing better is important.

Designing the Experiment : The teachers talked several times about the best way to test their tentative belief that emphasis on the biography of admirable historical personages would have beneficial effects on the character of their pupils. The design or plan finally agreed upon involved trying to find out, at the beginning of the

year, (1) how much their pupils knew about famous persons whose biographies were to be stressed, (2) the extent to which these persons were admired, and (3) the reputation of the youngsters among their classmates in respect to the several traits listed above on page 19.

"Greater emphasis on the biographical method" was defined as involving the introduction, in all history classes, of certain episodes dealing with the character of famous and admirable persons. In addition, a limited number of motion pictures, which all boys and girls would see, were selected and each member of the staff agreed to relate orally to his class, whenever an occasion presented itself, incidents from the lives of an agreed open list of famous persons that called attention to their strength of character.

The plan also involved getting evidence on items 1, 2, and 3, above at the end of the year and comparing "before" and "after" scores. This, the teachers thought, would enable them to find out how much their pupils learned about famous historical personages, the extent to which their admiration for such persons had increased, and the extent to which their reputation among their peers for the five traits agreed upon had been affected.

This experimental design was by no means perfect. There was no real agreement among the teachers regarding the time each would devote to emphasizing biography or the teaching methods that would be employed. No attempts were made to see what might happen to another group of pupils, called a "control" group in research language, that received a year of the usual instruction in history. But in spite of these limitations, the design represents real progress in comparison with what was done by the "common sense" group of teachers, progress from subjective, casual, non-scientific inquiry towards more careful, more thoughtful, research procedures.

Obtaining Evidence: One indication of the superiority of the problem solving methods employed by the more research minded teachers was their attempt to get evidence, to get facts. We have already commented upon the method used to measure character. The teachers were ingenious in developing rather good tests and other procedures that enabled them to get a variety of facts about their pupils. They seemed to realize that facts were essential for good problem solving.

For example, to get a quantitative measure of the degree to which the pupils admired well known historical personages test items like the following were evolved, tested and adopted.

Directions: Listed below are the names of twenty-eight people.* Historians have considered their lives to have had a sufficient effect to have recorded their activities. You will notice that there is a space () at the left of each name, and another space () at the right of each name.

* Teachers in India can as well substitute Indian names and undertake a similar study.

If you feel any degree of admiration for the person named, put an X in the space at the left. If you dislike the person, or have no feeling about the person, leave the space blank. Do not do anything with the space at the right of each name until you have checked all names for which you feel admiration. Then you will find the directions for the space at the right at the bottom of the page.

() John Marshall	()	() Nathan Hale	()
() Benjamin Franklin	()	() George Washington	()
() Samuel Adams	()	() Roger Williams	()
() Paul Revere	()	() James Madison	()
() T. Jefferson	()	() Thomas Paine	()
() Abraham Lincoln	()	() Daniel Boone	()
() Robert E. Lee	()	() Meriwether Lewis	()
() Stonewall Jackson	()	() John Q. Adams	()
() U. S. Grant	()	() George R. Clark	()
() Harriet B. Stowe	()	() John Brown	()
() Daniel Webster	()	() John Paul Jones	()
() Sam Houston	()	() Andrew Johnson	()
() Sir Francis Drake	()	() William Penn	()
() Andrew Jackson	()	() John Smith	()

Directions for the right hand column: In the space at the right of each person you indicated you admired describe the extent of your admiration by using the following scale:

Admire exceedingly	5
Admire a great deal	4
Have considerable admiration	3
Some admiration	2
Little admiration	1

Thus, if you have exceedingly great admiration for George Washington place a 5 at the right of his name. Rate each person you checked. Rate him according to the way you really feel. There is no "right" or "wrong" in this test.

A pupil's score was the sum total of the numerical value of his entries in the right hand column divided by the number of entries. This yielded an "average admiration index".

A different kind of test was worked out to yield a measure of the pupils' *knowledge* about famous historical personages.* One item from this test is reproduced below :

Directions : In the column at the left will be found a list of names of people who were important in the history of your country. In the column at the right will be found a numbered list of phrases. Place the number of the correct identifying phrase in the space at the left of each name. Because there are fewer names than identifying phrases, some of the latter will, of course, not be used.

Example : 13—Christopher Columbus Reached West Indies in 1492.

<i>Names</i>	<i>Identifying Phrases</i>
—Benjamin Franklin	1. Inventor of first practical steam-boat
—George Washington	2. "Father of the Constitution"
—John Marshall	3. Founder of Delaware
—Nathan Hale	4. Author of Declaration of Independence
—Samuel Adams	5. Inventor, scientist, statesman, and publisher
—Roger Williams	6. "I regret that I have but one life to give to my country"
—James Madison	7. Pre-revolutionary agitator for freedom
—Paul Revere	8. Chief Justice of Supreme Court
—Thomas Jefferson	9. "Old North Church"
—Thomas Paine	10. Founder of Rhode Island
—Christopher Columbus	11. Author of "Common Sense"
	12. Military leader, statesman, chairman of the Constitutional Convention
	13. Reached West Indies in 1492

A pupil's score was the total number of correct associations. On this one item the maximum score would be 11.

The test and scales these teachers used to get evidence, to get facts, were not completely satisfactory. The teachers, however, did try to

*Reproduced from the reference printed on the bottom of p. 19. Indian teachers can frame a test about famous historical personages of India.

find out how accurate their tests were (See "Reliability" Ch. VII). Knowing that accuracy is important was another indication of the extent to which these teachers valued the research approach to dealing with classroom problems.

Little was done to determine whether or not the tests really measured what the teachers wanted to measure (See "validity", Ch. VII). The teachers assumed that their "matching" items measured pupil knowledge. They assumed that their items intended to measure pupil admiration of famous historical persons did measure pupils' admiration. It is quite possible, of course, that a pupil's choice of a number from 1 to 5 to represent the degree of his admiration was almost a chance choice. The pupils had heard little about many of the historical persons. As is reported below, knowledge about a person and admiration for him, as measured by the tests used, were not at all related.

Despite these limitations, the realization that facts are essential to the definition of a problem and to the testing of the consequence of action hypotheses, and the willingness to try to obtain these facts, represent a further long step in the direction of better research procedures.

Generalizing: The "before" and "after" evidence was examined at a meeting of the teachers at the end of the year. They invited a consultant to attend the meeting who had had experience treating research data statistically and interpreting them. There was almost no relationship between a pupil's score on the test of information about famous personages and his expressed "admiration" for them either at the beginning or end of the year as measured by a "coefficient of correlation" (See Ch. XI). Similarly, there was no relationship between the pupil's "admiration" scores and the reputation the pupils had among their peers for good character.

This evidence led the teachers to conclude that (1) the possession by pupils of information about historic personages had little effect on their admiration of these personages, (2) one year of instruction in history, with emphasis on biographies, did not noticeably increase the extent to which boys and girls admired the persons whose biographies were studied and (3) there was no relationship between the extent to which boys and girls admired famous historical personages and the reputation the pupils had among their peers for demonstrating the traits of the admired persons.

These conclusions were quite disturbing to the teachers. Admittedly, they were based on data yielded by measuring instruments and an experimental design that were imperfect. There was a strong tendency, too, for the teachers to overgeneralize the results and fail to limit them to the specific circumstances of the study. The teachers knew, however, that the conclusions were inferred from better evidence and a better method of trying to solve this particular problem than

they had ever used before. Consequently, the teachers had considerable confidence in their findings.

Criticisms of Teachers' Classroom Experimentation

In the above review of the classroom experimentation or "action research" conducted by a group of teachers who had had some experience in scientific problem solving, several limitations have been pointed out. A few readers, especially those who know a great deal about the design of educational research studies, have undoubtedly identified additional weaknesses and have said to themselves: "Why didn't someone tell them how to do it better? Why spend all this time doing research if it cannot be good research? Conclusions based on poor research procedures cannot be depended on."

These questions and the final comment are important. They are similar to those frequently made when teachers talk about the research or experimentation they have engaged in to improve their decisions and to evaluate the practices resulting from these decisions. In this case the answer to the question, "Why didn't someone tell them?" is that someone did,—many times. Whether or not these research suggestions made by a consultant—supervisor were accepted and understood and acted upon, however, depended on a number of factors. Most important of these was the basic motivation the teachers had for undertaking the inquiry at all, namely, their desire to teach in such a way that the character of the pupils would be improved. If suggestions about experimental design and statistical treatment of data seemed to the teachers to lead them away from their main interest, no attention was paid to the suggestions.

Another factor that influenced the acceptance of research suggestions by the teachers was the time available. Practical judgments were constantly being made about the desirability of research refinement, some of which required a great deal of additional time. All the members of the group had full teaching schedules. Finally, no suggestion about a better research procedure got more than courteous attention unless the importance and feasibility of the suggestion was clear to the teachers. In other words, if their general experience, re-examined and re-evaluated, did not support the arguments advanced in support of certain research refinements, nothing happened.

The contention that educational research should not be undertaken unless it can be good research is a vague one. Advocating that a group trying to improve its practices engage in the best research it is capable of, and strive for improvement in the future, has much more meaning. The research capabilities of the members of a group of teachers are influenced by their previous experience with scientific problem solving, by the time they have available to study their teaching, and by the ways they have adopted to take decisions and evaluate actions in the past. The contention that conclusions based on poor research methods cannot be depended on is true. This is not an area where absolute judgments are justified, however. The important point is that *better* research results in *better* conclusions.

Conclusion

We have tried in this chapter to show that the quality of the inquiry and experimentation teachers undertake to improve their decisions and actions is relative. No research conforms to absolute standards of quality. Excellent research involves a method of inquiry that justifies a high degree of confidence in its results. All instances of problem solving, however, involve defining a problem, hypothesizing or predicting the result of a certain course of action, developing a design to test the hypotheses or prediction, getting evidence, and generalizing from this evidence. To the degree the quality of the definition, of the hypothesis, of the design, of the evidence, and of the generalization is high, school experimentation by teachers has good results. This means that it will lead to consequences that the teachers desire.

CHAPTER V

WHAT ARE THE ASPECTS OF THE RESEARCH PROCESS?

In the preceding two chapters we described how different groups of teachers went about trying to improve a similar situation that troubled them, the indiscipline of their pupils. One group did what most teachers might do. It used common sense. The second group used research as a way of improving student indiscipline.

In each of these two chapters we analyzed what the teachers had done by referring to various aspects of the problem solving or research process. We commented on problem definition, focussing the problem, analyzing the problem or trying to get at its causes, searching probable remedies or solutions, hypothesizing or predicting that certain actions chosen from a number of alternatives might solve the problem, testing the hypothesis in an experiment, and generalizing from the results.

In this and the following chapter we take a closer look at these several elements of the action research or problem solving process. Each of them is important. It is almost impossible to start to work on problem that is poorly defined. A teacher who says he is disturbed because his students use poor judgment, and he wants to do something to improve their judgment, is talking about a genuine problem but it is a most vague one. What does he mean by judgment? What kind of evidence does he have that their judgment is poor, taking into consideration the age of the pupils? Answers to these questions result in better *problem definition*. A carefully defined problem is partly solved.

Another aspect of the problem solving process is focussing or trying to "*pin point*" the difficulty. A problem whose scope is very comprehensive presents almost insurmountable obstacles to research by teachers. The illustration involving a teacher's concern with the presumed poor judgment of his pupils is a case in point. No matter how carefully the teacher defines this problem, no matter how much he clarifies what the problem is, it may remain so broad in scope as to discourage research and experimentation. To do something constructive a classroom problem must be narrowed down from a broad area to a focussed, specific, difficulty. In this case the teacher had better select from his broad problem area, "the pupils use poor judgment", a more circumscribed concern such as : "When my pupils read or hear about social or economic data that are in statistical form I seem unable to teach them to make correct inferences." This problem, or teacher dissatisfaction, has focus. The focus makes it possible to proceed.

After the practical problem has been defined and focussed, whether or not it is solved will depend upon (a) the care with which the

teacher makes his diagnosis to get at the causes of the difficulty, (b) the thoroughness with which he searches out and thinks critically about various possible remedies or solutions, (c) the preciseness with which he formulates his prediction (hypothesis) that certain actions he will take will lead to desirable consequences, and (d) the adequacy of the design of his experiment to test the prediction or hypothesis. If the research is of high quality, the problem is apt to be solved or, at least, its seriousness reduced. If the research is careless and unsystematic much time is wasted and the problem will probably remain unsolved.

•What Precedes the Problem Solving?

There are certain forerunners of the actual process of action research or classroom experimentation. Understanding them gives the research process more meaning.

Dissatisfaction with own Teaching : Before any teacher will undertake problem solving or research to improve his teaching there must be some aspect of his teaching which he wants to improve. If a teacher is quite satisfied with what he is doing it would be foolish, from his point of view, to try to change. This does not mean that a teacher who seems to be satisfied with his teaching should be satisfied. He may be a poor teacher in the judgment of his superiors. The point is that he will not make efforts to improve on his own initiative unless he is dissatisfied. The authors of this book take the position that many if not most teachers are serious about their own professional improvement and are frequently dissatisfied with the way they teach and are keen on improving their practices. There are some school administrators and inspectors who feel differently. They contend, often indirectly, that any program of teacher improvement that assumes teachers want to improve the way they teach is leaning on a weak reed. Our work with teachers has taught us differently, although we admit that our dissatisfaction with certain aspects of a particular teacher's instruction is not always agreed to by the teacher concerned. Maybe a similar experience is what misleads many school administrators.

When a teacher becomes dissatisfied with his own teaching he does so for a reason. The reason, as we have said before, is that he sees too great a gap between what he wants his teaching to accomplish and what his pupils seem actually to be learning. In Chapter II we gave many illustrations of teachers whose dissatisfaction with their own teaching grew out of the realization that they were not accomplishing with their students what they wanted to accomplish.

Some disparity between one's aspirations and his achievements is, of course, tolerable to everyone but the rare perfectionist. When this gap becomes too great, however, something, apparently, must be done to reduce it. A teacher may do any one of the several things. He may modify his teaching aims. He may say to himself, "Trying to teach these general science students anything about ionization is

not possible. They cannot be expected to have sufficient background. I feel as if I were butting against a brick wall. I am not even going to try it anymore." Another teacher might say, "Teaching crafts for productive work in a primary (Junior Basic) school is a waste of time since it can hardly fulfil its objectives with such an age group as 6-11." It may be argued by some that teaching through concept and practice of self-government in schools is impossible when the child's environment in his home or society rewards him for following orders.

The second thing a teacher may do when he becomes aware of a gap between what he wants to accomplish by his teaching and what he thinks his students are learning is to "project" responsibility for this on someone else. The teacher might say to himself, for example, "How can I be expected to teach geography to these pupils without good maps? If the headmaster won't get me better maps I can't help it if they learn very little." Another teacher might say, "I just can't do anything about my pupils' wretched pronunciation. Look at the homes they come from". Another might project responsibility for his failure by saying, "How can I teach physics and chemistry when the school laboratory has hardly any equipment or apparatus?"

The third thing a teacher might do when he notes a disparity between what he is trying to accomplish and what he believes he is accomplishing is to decide to try to change his own teaching by doing something he has already had good experience with under somewhat different circumstances. He might say to himself, "Maybe the difficulties these pupils are having with solid geometry is that we don't have any standard three dimensional models that will help them visualize the problems. I have used such models before and I am sure that doing so would help. What I will try to do is to get the craft teacher to make some models for me and use them."

A fourth teacher reaction to dissatisfaction with his own efforts to teach what he wants his pupils to learn is especial significance for classroom experimentation. This fourth reaction might lead the teacher to say to himself something like this: "I can't seem to get across some very important ideas in geography. They have to do with the fact that lowered atmospheric temperature causes clouds to release rain and that going over mountains gets clouds up where it is colder. That's why they dump their moisture on the wind-ward side. I've tried everything I can think of and it doesn't seem to work. I must discover some better way to teach these ideas so that they are learned and remembered."

Whenever a teacher, (1) becomes dissatisfied with his own teaching as the result of effects that he himself notices, (2) tries but without success what he has already learned how to do, and (3) comes to the conclusion that he must discover *a better and a more effective way*, he has taken the first step towards classroom research or experimentation. It might be said in passing that for a teacher himself to conclude that his teaching is not effective or satisfactory is quite different from

having someone else tell him that his teaching is poor and he *should* be dissatisfied with it. Dissatisfaction with one's self generally leads to a desire to do better. Criticism by others generally leads to defensiveness and self justification or, at most, a desire to please the critic if he is in a position either to punish or reward.

Hope : For a teacher to be dissatisfied with his own teaching will probably not lead him to make much effort to improve unless he has at least a degree of hope that he can do something to improve it. When hope is not present self dissatisfaction is more apt to lead to frustration and discouragement than to constructive experimentation. An illustration of the importance of hope is the case of the Basic school teacher who felt that he was unable to teach general science successfully to the 8th standard because he felt (a) that his class was entirely too large, and (b) there was no chance of getting space or equipment for any practical work. This teacher's dissatisfaction with his teaching was genuine but he could see little to do about it. He was discouraged because he had no hope that anything he might do could make his class smaller or provide for practicals. This teacher may have been wrong in his convictions but as long as he felt as he did, hopeless, he did nothing to improve. The importance of hope in teacher experimentation is sometimes unappreciated. More attention should be given it by anyone who is interested in improving teaching.

The Research Process

Self-dissatisfaction,—a realization that what has already been learned is not adequate,—the resolve to discover better ways, and the hope that the better ways will work, lead directly to the research itself. We next turn our attention to the various aspects of that process.

Problem focus : A teacher who is dissatisfied with his own teaching, even when he has some hope of being able to improve the situation, will find it difficult, if not impossible, to take constructive action if his dissatisfaction is too general. For example, a teacher might be greatly dissatisfied with his attempts to teach geography to the 5th class children. If he narrows this problem down no further it is almost impossible for him to know where to start to improve. The problem that leads to his dissatisfaction is too extensive. He does not know where to take hold. When this teacher, however, is able to single out of his general dissatisfaction a more focussed teaching problem he is more apt to undertake to improve his teaching.

If this 5th class geography teacher selects out of his general dissatisfaction his more specific concern about not being able to teach his pupils map reading, this focus will help him get started doing something constructive. Sometimes a teacher needs help in achieving this focus. He must realize that trying to change *too much* is rarely successful. His attempts to focus often lead to more penetrating

thinking about the general problem area. A teacher who is asked, for example, "What particular English mispronunciations bother you most?" must think more critically about his general dissatisfaction with English pronunciation before he can answer.

Problem definition : After his teaching difficulty has been focussed and narrowed down, the teacher interested in experimenting to improve himself tries to define his problem carefully. To continue the illustration of the 5th class geography teacher who was dissatisfied with what he had been able to do to teach his pupils to read maps, he would define quite exactly what he meant by map reading. Map reading is a complex activity. What is a map? Does map reading ability mean that a pupil can look at a map and answer questions about it? Should it also mean that a pupil can use a map to find something or travel to a designated place? Is map drawing an integral part of map reading? These and other similar questions must be answered if the problem is to be carefully defined.

Part of defining the problem is getting some evidence about its extent. Changing the illustration let us assume that a group of teachers in a Basic school for boys felt that there was far too much interpersonal antagonism and unfriendly feeling among the pupils in the 6th, 7th, and 8th standards. They wanted to experiment with ways and means of reducing the unfriendliness. Let us assume, furthermore, that after considerable discussion and exchange of views the problem was narrowed down to: "reducing the fighting by the boys on the school grounds before and after school and during recess." Fighting was defined as "Doing anything with the intention to hurt another boy physically." Specific instances were to include the following :

- (a) striking another boy in anger,
- (b) throwing him to the ground,
- (c) tripping or shoving with the intent to hurt,
- (d) throwing stones or other materials with the intention to hurt.

These teachers might next want to get some evidence about the extent of this problem. The following plan would have merit :

1. Careful observations would be made, for a three day period, of instances of fighting as defined above. The observation would be made for half an hour before school starts, during all recess periods, and for half an hour after school ends.
2. Teachers would volunteer for the observations, two teachers to a team. One would observe, the other record the observations. This would be done so as to attract as little attention as possible.

3. A simple proforma like the following might be used for observations :

1. Period of observation_____

Observers
recorder_____

observer_____

<i>Kind of fighting</i>	<i>[Boys involved—boy who started it first]</i>
(1)	(1)
(2)	(2)
(3)	(3)

4. At the end of each day a summary would be prepared indicating the boy's name in each case and the kind of fighting.
5. At the end of 3 days a total summary would be prepared giving the name of each boy who had fought, and what he had done each time and to whom.

Getting evidence in the course of defining a problem has many values. These teachers might learn that just a few boys were starting almost all of the fighting. The evidence might show that the fights were always between boys from different communal groups. They might learn that the fighters were usually the boys who were retarded in school and would quit school if they could. Each of these "findings" would influence what the teachers might do to try to improve the situation. They would at least base their decisions as to what to do on better knowledge about the fighting in the school.

Getting evidence on the extent of a problem serves another important purpose. It provides teachers with important "base line" information. This information could be used to estimate the progress the pupils make should the teachers decide to experiment with different ways and means of reducing the fighting.

Getting some objective evidence about the actual behaviour or achievement of pupils in respect to the particular kind of situation with which a teacher is dissatisfied is an extremely critical part of the action research or classroom experimentation process (See Chapter VII). Guessing, or making vague subjective estimates about what is going on does not satisfy the teacher who is doing research to improve himself. He finds that he frequently must develop new instruments, tests, scales, or rating proformas in order to get better evidence of behaviour, attitudes or subject matter achievement. (See Chapters VIII, IX and X).

Analysing the Problem : After a teacher has carefully defined his problem, and has obtained some objective evidence in order to

understand better its nature and scope, he moves next to a careful diagnosis. This means that he does his best to search for reasons for the existence of the problem. This can be illustrated by referring again to the 5th class geography teacher who became dissatisfied with his attempts to teach map reading. After defining clearly what he meant by map reading, and after getting evidence about the map reading competence of his pupils, this teacher would try hard to identify the reasons for the unsatisfactory work in map reading.

These reasons must be determined before anything else can be done in the research. The more carefully they are identified the more likely the problem will be solved. Whatever the teacher decides to do to improve his teaching of map reading will be done because he believes it will either eliminate or reduce the influence of one or more of the reasons for the poor map reading. This sentence should be well understood. It calls attention to another critically important aspect of action research or classroom experimentation. As has been said, it is as necessary for a teacher to diagnose carefully and get at the reasons for the situation he wants to improve before he tries to do so as it is for the doctor to diagnose his patient's illness carefully before he prescribes medicine or other treatment.

A diagnosis of the problem having to do with map reading might be helped by the use of a proforma like the one suggested below :

(1) Possible Reasons	(2) Based on		(3) Can teacher do anything		(4) Estimated order of significance
	Facts	Conjecture	Yes	No	
a. No good wall map in the school	✓			✓	
b. Children get no experience with maps outside of school		✓		✓	
c. The significance and usefulness of maps not made clear		✓	✓		2
d. Lack of certain basic concepts especially "scaling"			✓		1
e. Lack of practice in map drawing.	✓		✓		3

The columns in the proforma are numbered 1, 2, 3, and 4. In column 1 the teacher in our map reading illustration might list what he believes to be the major reasons for the poor map reading. Column 2 enables the teacher to indicate whether each reason is based on facts, on evidence, or upon speculation. If the teacher, as in the example, suspects that one of the reasons for poor map reading is ignorance of the concept of "scaling" ($\frac{1}{4}$ inch to the mile, etc.) he

would proceed to try to get some facts to find out whether or not this suspected reason is actual. He might, for example, ask the best map readers among his pupils, and the poorest readers, some questions about "scaling" to see if they answer differently. If the poor map readers became quite confused as they tried to answer the questions the teacher would have obtained some objective evidence in support of his belief that ignorance of scaling was at least one reason for poor map reading.

In column 3 the teacher might check those reasons for the difficulty about which he thought he could do something. Sometimes an important reason is beyond the control of the teacher. If, to use another illustration, a teacher of Hindi were to establish that one major reason for the poor language used by his pupils is the quality of the language some of them hear spoken in their homes, this particular cause is something about which the teacher can do almost nothing. The teacher in the geography illustration ticked "No" in column 3 after the first two reasons. In other words he felt there was nothing much he could do about getting good wall maps or giving pupils more map reading practice outside of school.

Unless it is possible for a teacher to check one or more of the important reasons in column 3 to indicate that he can do something about them, there is little hope that he can improve the situation. He had better experiment with some other aspect of his teaching.

Column 4 in this proforma enables the teacher to rank his estimated order of the importance of the various reasons for the difficulty about which he feels he can do something. This geography teacher, after getting as much evidence as he could, might decide on the order indicated in this column. He furthermore decided to concentrate on improving his teaching of "Scaling".

In the next Chapter we continue our discussion of the action research process.

CHAPTER VI

WHAT ARE THE ASPECTS OF THE RESEARCH PROCESS?

(CONTINUED)

In the previous chapter the analysis of the research process was carried through the phase known as "problem diagnosis". In this chapter the other aspects of the research process are discussed :

Search for solutions : After his diagnosis of the problem the teacher begins his search for things that he might do to cope with it. This means that he hunts for possible changes in his own teaching practices that might eliminate or at least reduce the influence of one or more of the causes of the difficulty. This search is best if it involves using all of the resources the teacher can get access to. Referring again to the illustration about map reading, this teacher might talk to his fellow teachers about the experiences they have had in teaching map reading. He might try to get and read some books or articles or even some research studies having to do with the teaching of geography. He could ask his headmaster or inspector for assistance. He should, of course, carefully examine and evaluate his own past experience with teaching map reading.

For a teacher to examine carefully his own past experience in a situation when he is trying to find out what to do to improve it, deserves emphasis. Most of us in school and college have been taught to examine critically the experience some one else has had and written about. We are supposed to read critically, and look for flaws in arguments, or conclusions that are not justified by the evidence. Few of our teachers, though, have tried to help us re-examine *our own experience* and learn important lessons from it. This kind of re-examination of one's own experience, as critically as possible, is helped if another person lends a hand. He must be a special kind of person, however. He must be willing to listen carefully, not talk all the time as many people trying to give help are inclined to do. He must be able to ask good questions without threatening. He must support and not scold. A consultant or helper with these characteristics can greatly assist teachers as they try to get better insight into the real nature of their problems and what might be done about them.

To illustrate this consulting or helping process we are reproducing below a near verbatim record of a conversation between a teacher, Mr. Ram, and a consultant, Mr. Mehta*. The teacher came to the consultant for help on his action research project. The two men greeted one another, engaged in a few minutes of friendly conversation, then got to work.

*See *Workshop on Action Research*, Teachers' College, Mysore, Department of Extension Services, 1961, p. 90 f.

Mr. Melita : I understand, Mr. Ram that you teach in a boys' higher secondary school? Am I correct?

Mr. Ram : Yes, sir. A rather large urban school.

Mr. M. : What is it about your teaching that dissatisfies you?

Mr. R. : I am a teacher of social studies. I feel I have failed to inculcate a sense of discipline in my pupils through lessons in social studies. I have tried but I have not been successful. (slight pause)

Mr. M. : What makes you feel they are not disciplined, Mr. Ram?

Mr. R. : Well, Sir, I am dissatisfied with their general behaviour.

Mr. M. : What kinds of things do the boys do that make you unhappy about their behaviour? What indiscipline have you observed?

Mr. R. : For instance, their behaviour in the canteen or while listening to a lecture in the assembly.

Mr. M. : I see. They misbehave in places like the canteen or in the assembly hall. This can be very distressing. What, specifically do they do, Mr. Ram, when they are misbehaving?

Mr. R. : Oh, I see what you mean, Sir. In the canteen they may drop food on the floor or talk too loudly or..... Maybe I should try to observe them more carefully, Sir, to see exactly what does happen. Would you suggest this?

Mr. M. : Yes, that would be a good idea. You might develop a simple proforma that would help you record what you see.

Mr. R. : Yes, I shall try that, — in the assembly hall, too.

Mr. M. : Yes. Have there been some students whose behaviour is satisfactory or is the indiscipline general?

- Mr. R. : The behaviour of a few students, Sir, is commendable.
- Mr. M. : What do you suppose might be the percentage of misbehaving pupils ?
- Mr. R. : I am sorry. I have not tried to ascertain.
- Mr. M. : If only a few of the students are causing most of the trouble would this be important to know ?
- Mr. R. : Yes, it would, Sir. I shall include in my record of indiscipline in the canteen and lecture hall the names of students along with a brief description of the nature of their misbehaviour.
- Mr. M. : Why do you think the students misbehave, Mr. Ram ? What are the causes of this indiscipline ?
- Mr. R. : Well, sir, I guess I don't know, actually. I've assumed they were just wilfully bad. I suppose.
- Mr. M. : Did you ever misbehave in high school ?
- Mr. R. : (laughing) Sir, come to think of it I did, now and then.
- Mr. M. : Why ? Were you "wilfully bad ?"
- Mr. R. : No, not really, I guess at the time I felt I had a good reason.
- Mr. M. : Might your pupils, too ?
- Mr. R. : I hadn't thought of that. Maybe I should try to find out from them, if I can, why they misbehave.
- Mr. M. : That might help.

The reader will note that Mr. Mehta, who was trying to help Mr. Ram, did not tell him what to do. He asked questions and encouraged Mr. Ram to re-examine his experience with the indisciplined students. As a consequence Mr. Ram decided to do something he had not thought of before. The consultant helped him think about his problem more adequately. He did not try to solve it for him.

As a result of all of his attempts to get assistance and use the resources available to him the teacher trying to improve his instruction in "map reading" might identify a number of different things which would give some promise of improving the map reading ability of the pupils. Each of these separate ideas would be examined carefully in relation to the teacher's diagnosis of the problem. Each suggested "remedy" for the situation the teacher is trying to improve would be tested in the teacher's imagination. In other words he would try to estimate its consequences.

Hypothesizing: In due course this teacher must decide to try out one or more of the most promising solutions to the map reading problem. What he does when he makes his choice is to formulate a hypothesis which is to be put to test in an experiment. An hypothesis in this sense is a prediction that certain actions will result in certain consequences. Continuing the map reading illustration, the hypothesis to be tested might go like this: "If I (a) emphasize the idea of scaling by having the pupils make scale drawings of familiar objects and areas, and if I (b) use the scales against the actual areas and objects for estimating distances and sizes, then the map reading of my pupils will improve."

It will be noted that this hypothesis is in two parts. One describes two actions the teacher will take. He will have the pupils make scale drawings and use the scales in estimating distances and sizes. The second part predicts a consequence of these actions: "The map reading of my pupils will improve."

The more explicit and detailed the description of the actions to be taken the better it is. For example, two teachers might be concerned about their pupils' misunderstanding of current events. They define the problem similarly and their analysis leads each of them to conclude that dull presentation of news at the morning prayer and the lack of opportunity to discuss the news with one another and their teachers are the two important reasons for the misunderstanding. They conclude too that they can try to do something to reduce the influence of these reasons. Each teacher, however, formulates a somewhat different hypothesis to test. One goes like this: "If the morning news announcements are made more interesting and the pupils are encouraged to ask questions afterward the pupil misunderstanding of news will be reduced."

The second teacher formulated this hypothesis: "If I (a) help the pupils dramatize news events twice a week, (b) train several of the best pupil speakers to comment on and interpret the dramatizations, and (c) have a different panel of 4 students discuss the news briefly after each dramatization and comment, the pupil misunderstanding of the news will be reduced."

It is evident that the second teacher was much clearer and much more explicit in his ideas as to what actions he would take to try to improve the pupil's understanding of current events. Should each

of these two teachers conduct an experiment the second one would know much better than the first just what it was that caused better understanding of current events if better understanding resulted.

Whatever action a teacher contemplates taking in his classroom, his experimentation should conform to certain principles. Some of these principles are listed below :

1. The action must be one that the teacher himself can bring about. Actions that require other people to change had better result from cooperative experimentation in which these other people are involved. Sometimes a teacher must acquire some new skills in order to take a particular action. If an hypothesis, for example, is a prediction that pupils will learn better how to use their historical information in dealing with historical problems if the teacher employs many "thought" questions in his weekly tests, the teacher first must learn how to formulate thought questions. Similarly, if a teacher's hypothesis requires him to plan activities with his pupils rather than telling them everything they must do, he must first learn how to plan with pupils.
2. Whatever it is the teacher intends to do must be in harmony with school policy. This is only common sense. A teacher should not plan an experiment, for example, that involves taking pupils away from school for long periods which will cause them to miss other classes. Similarly, if it is the school policy to assign homework a teacher should not try to test an hypothesis eliminating homework in his classes only.
3. The teacher's actions should be such as not to interfere unduly with the routine activities of the school. Any experiment or decision on the part of a teacher that causes pupils to remain absent from morning assembly or physical exercises or cultural programme or daily craftwork interferes with a school's organised routine activities and hence should be avoided.
4. The action should be one whose consequences can be measured within a reasonable period of time. School experimentation or action research, especially the first a teacher undertakes, should not cover too much time. Three months or four at the outset are suggested. Other related studies can, of course, be taken up as soon as one is finished.

Designing the Experiment : After the teacher has decided what it is he wants to test he then develops a plan, a research or experimental

design, a way of testing his hypothesis. These research plans or research designs usually involves giving attention to several research problems. The first involves developing ways and means for getting evidence on the extent of the problem. This has been mentioned above under the heading "defining the problem". As was said there, getting this "bench mark" evidence often requires great ingenuity on the part of the teacher-investigator. The more he knows about educational measurements the better off he will be.

How would you go about getting rather exact "bench mark" evidence about the extent of the classroom problems implied in these teachers' statements?

1. The attitude of my pupils towards homework is bad.
2. My pupils can memorize general science principles but they don't understand them.
3. Learning about a craft just isn't important to most of the boys.
4. I can't cover the ground in history in the time allotted to me.
5. I find that many pupils of my class know how to work out text-book examples in Arithmetic but when they are put oral or written questions based on realistic dealings in the market they miserably fail.
6. In spite of self-government and regular morning assembly some pupils showed a great lack of responsibility and discipline.

Very often the more important the evidence is the harder it is to get. It is, for example, easier to get evidence on pupils' spelling ability than on their ability to use language. Most people would admit, though, that using language well is more important than spelling well. Similarly, getting evidence about the weight of pupils is much easier than getting evidence about their attitudes. Getting good evidence is so important in classroom experimentation or action research by teachers that four chapters in this book (VII, VIII, IX and X) are devoted to it.

After planning how he will get his "base line" data or evidence, and the instruments he may need to construct to do so, the teacher next describes carefully just what action he is going to take. The importance of describing these actions in detail has been commented on above under the heading: *hypothesizing*.

The third aspect of the experimental design is planning a procedure for getting evidence regarding the degree to which the pupils have or have not improved. Referring again to the map reading illustration, evidence must be procured for the teacher to learn whether or not the pupils are better at reading maps after the increased emphasis on scaling. This evidence should result from a repetition of

the methods used when evidence was procured to define the problem. Only if this is true can the "before" and "after" evidence be compared.

In order to be carried out expeditiously the design or plan for a teacher's experiment should be laid out "timewise" with target dates. An actual written design* prepared by a secondary school teacher looked like this :

The Problem : Dissatisfaction in general with success of teaching science to 8th Standard students.

Focus : What can be done to create more interest among the pupils in physics ?

Diagnosis : The proforma below was used with the indicated results in the analysis or diagnosis of the problem.

1	2		3		4
Possible causes for lack of pupil interest in physics	Is this cause		Can teacher do anything about it ?		Causes teacher will try to do something about
	fact ?	Conjecture ?	yes	no	
1. Lack of practicals in physics	x		x		x
2. Little discussion of physics among pupils		x	x		x
3. No modern demonstration equipment	x			x	
4. Few interesting physics books	x			x	
5. Science background inadequate		x		x	

To get some evidence on cause number two the teacher planned to interview some of the pupils to learn whether or not they talked about physics very often in their informal conversations.

The action hypothesis : After taking a decision to try to do something about causes 1 and 2 and after seriously considering several possibilities, the following action hypothesis was formulated :

"If I (a) arrange a practical class for all pupils twice a week, and (b) provide a fortnightly class period for pupil discussion of physics, interest in the subject will improve."

* This plan is only a slight modification of the design prepared by M. V. Seshadri at the ACTION RESEARCH WORKSHOP held in 1961 at the Government Teachers College; Mysore. Mr. Seshadri was at the time the Science Assistant in the Higher Secondary School, Hathur, Mysore.

Design of the Experiment with Time Targets

1. (By Jan. 1) A "pre-experiment" measure of interest in physics will be developed and administered to all pupils. This probably will involve two tools or instruments. One will be a request for each pupil to rank all of the subjects he is taking in order of his interest in them. The other tool will probably be a five point scale enabling the pupils individually to tick mark a point on the scale which describes the degree of their interest in physics. This same scale might be used to enable them to indicate what they believe to be the average interest of their friends in physics. The average ranking of interest in physics as compared with all subjects might be used as a "benchmark" indication. The same use might be made of the average scale value. The difference between the average scale location of ticks for physics by self and estimated for friends may be of interests.

2. (January, February, March) Two practical classes will be held each week. The entire class will be divided into batches according to the availability of equipment. Much of the equipment will probably have to be home made. For doing this the teacher will try to locate books or articles on preparing "simple science equipment." May be the help of the craft teacher can be solicited.

In addition to the practicals, two class periods a month will be devoted to pupils' small group discussions of physics. This will probably entail some reading on discussion methods. It may be necessary to train discussion leaders from amongst the pupils.

3. (April 1) The same instruments used to measure "Interest in Physics" in 1 above will be used again after 3 months of practicals and class discussions.

4. (By April 15) The evidence from the 'before' and 'after' measures of interest will be compared, the whole experiment evaluated, and generalizations for the future worked out.

This plan for a classroom experiment would not be defended by its author as perfect. Presumably he has conducted his study by now. His plan undoubtedly was improved; at least it became more realistic, as he tried to carry it out.

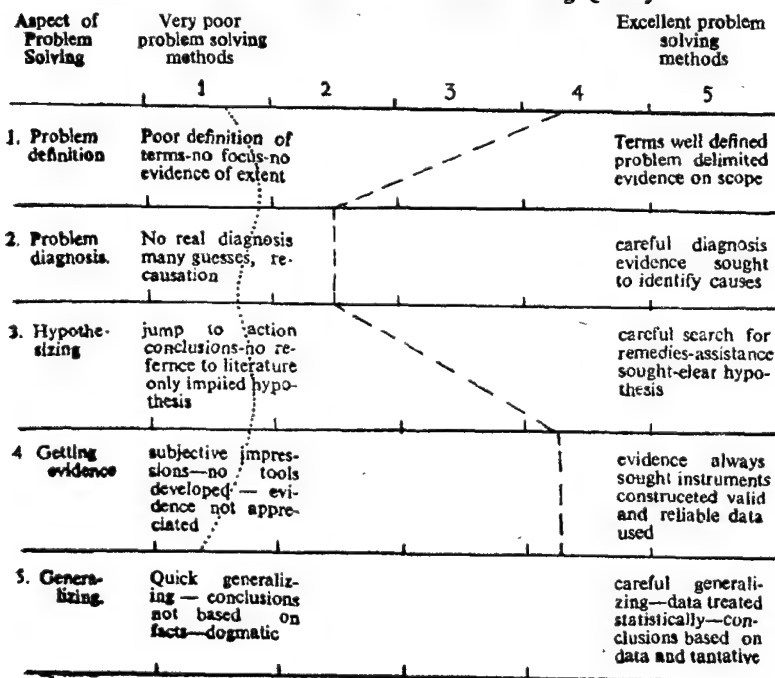
Measuring Research Quality

The above discussion has implied that the various aspects of the problem solving or action research process must be in a fixed sequence. This is not the case. His diagnosis of the problem might help the teacher to go back and define it better. During the course of his search for promising solutions the teacher might think of additional possible reasons to add to his diagnosis. The investigator, at least in his planning, finds that each step he takes often enriches what he has done. When this is the case, the enrichment should be incorporated in the design.

If a teacher does his research thoughtfully and well, the chances are greatly increased that he will improve the situation that dissatisfied him. Careful problem definition, clear focussing, penetrating diagnosis, thorough search for remedies, precise hypothesizing, meticulous planning and sagacious generalizing mean that the experimentation is of high quality. Even then, however, every experiment necessitates some risk. If the outcome could be guaranteed, there would be no experiment.

The quality of a teacher's research must be judged as satisfactory or not in relation to many conditions. It is certainly inappropriate to apply any absolute standards of perfection. No one doing educational research, not even the Ph. D. student or his professor-guide, has achieved perfection. This relativity in appraising the quality of research can be illustrated by the use of a diagram. The one given below lists in the left hand column the various aspects of scientific problem solving or research. Reading left to right the scale goes from an extreme of careless, undisciplined, opinionated and biased inquiry to the opposite extreme of careful, systematic, and disciplined problem solving with great emphasis upon facts, upon evidence.

Scale to Measure Research and Problem Solving Quality



This diagram can be used to help analyze the quality of a particular instance of research or problem solving. The scale values, 1, 2, 3, 4, and 5 represent degrees of quality with which the researcher took care of each aspect of the problem solving process. We would rate the "common sense" group of teachers described in Chapter III at 1 or at most 2 in each instance (refer to the dotted line). The second group (Chapter IV) with more research experience and commitment might have these ratings, 4, 2, 2, 4, and 4 on the aspects of problem solving. (refer to the broken line). Would the reader agree?

CHAPTER VII

WHY IS GOOD EVIDENCE SO IMPORTANT?

In the first six chapters we used words like evidence, facts, observations and data very often. Our readers have probably either been impressed or puzzled by this emphasis upon facts when writing about research and classroom experimentation by teachers. Why is evidence so important to school people when they experiment? We have tried to make the answer to this question clear as we have gone along by using many illustrations. We have written about evidence and facts in connection with problem definition, with problem diagnosis, with "before and after" testing and with generalizing. Nevertheless, because we consider evidence to be extremely important, we are devoting this chapter to a further discussion of it. First we give a number of illustrations of the importance of facts, data, evidence, observations, in science as well as in the scientific way of dealing with classroom problems. Next we try to clarify what evidence is. What are facts? Finally, we comment on the characteristics of good evidence.

Facts and the Scientist

Few things are more important to any scientist than facts. He does everything he can to base his decisions and his conclusions on them. He constantly tries to improve the quality of his observations and facts. The teacher who is undertaking to solve some of his practical classroom problems by doing research or by experimenting is also a scientist in his own way. He, too, wants his conclusions to be sound ones. He, too, wants to base his decisions upon evidence and to evaluate their effects with still more evidence.

Not only does a scientist constantly seek evidence as a basis for his conclusions, he wants evidence whether or not it supports his existing convictions and prejudices. He seeks facts as a *basis* for judgment, not to justify the judgments he already has reached. It has been somewhat humorously said of some people that they base their facts squarely upon their conclusions. What does this mean?

Darwin, who was one of the greatest scientists who ever lived, knew the dangers of taking into account only the evidence that supported his convictions. It is said that he kept a special notebook in which he carefully recorded all observations which contradicted his speculations about evolution. He remarked to a friend that he did not need a notebook to record the evidence that supported his point of view. He could remember that easily. A careful teacher-investigator, doing research to improve his own teaching, is like Darwin in a way. He does not want evidence just to support his conclusions. He searches for evidence *before he concludes*. He wants facts for enlightenment not for support.

The part that evidence must play in making practical educational decisions is clear to readers who recall the basic argument of this book as it was developed in Chapter I. We insisted that teaching is a practical activity. This means that teaching involves taking decisions in regard to a situation and doing something about it. Whatever is done is inevitably based upon the best evidence the decision taker has at hand. After the action is taken, and it is always taken to achieve a purpose, a judgment must be made as to whether or not the purpose has been fulfilled. All of the decisions that a teacher or principal or inspector takes are good or bad to the degree they are based upon *wise inferences from good evidence*. Similarly, judgments as to whether or not what has been done is successful or unsuccessful are sound to the degree they are carefully derived from good evidence.

What is Evidence?

When we have written about evidence we have been using the word in a some what scientific rather than a popular sense. We have meant by evidence facts that anyone who wants to look for and who learns how to look for can see. In this sense we are talking about *public* evidence. We mean facts that are "out there"; facts that are available to the senses. A person who cites a dream he has had as an explanation for his action is not using the dream as evidence in the sense in which we use the word. No one else can possibly examine it. The *report* of a dream might be thought of as evidence, because the report could be examined by some one else. The dream itself could not be.

Because evidence is the foundation for sound conclusions, any well reported instance of research or experimentation includes a great deal of evidence. The basic data are usually not destroyed for some time after a study has been completed. One important reason for publishing all the evidence, or not destroying it right away, is to make it possible for anyone who raises a question about the study to see the data, should he care to do so, in order to determine for himself whether or not the conclusions were justified. One of the most commonly asked questions in scientific discourse is "May I see your evidence?" The inevitable answer of the scientist is, "You may."

In science most of the evidence that is sought and used results from observations in the form of measurements. Many of the facts that scientists use are made possible because of instruments that have been "calibrated." This means instruments that are designed to quantify observations and make it possible to report in standardized units of volume or distance or speed or weight or intensity. A ruler is an illustration of a calibrated measuring instrument or measuring tool.

Measurement represents an attempt to quantify evidence, to describe how much of it there is in units of an agreed upon magnitude.

Measurements can be very refined, like a "sigma" which, when used in reference to measures of time duration, represents one thousandth of a second. Measurement can also be quite coarse and approximate like describing a distance by the number of days it would take a man to walk it.

Shifting to an educational illustration, one teacher might say, basing his judgment on the evidence of his senses, "That pupil is good in arithmetic." Another teacher, using more refined evidence, might say "That boy stands second in his class in arithmetic." Still a third teacher, using still more refined evidence, might say "That boy's score on a standardized achievement test in arithmetic places him at the 87th percentile for his age."

The first teacher's statement does not tell anyone very much about the boy in question. For one reason we do not know what the teacher's standards for excellence in arithmetic are. The statement made by the second teacher is based upon somewhat more exact evidence and, tells us a bit more. We at least know that the boy is second in his class although we do not know how arithmetic achievement was tested, or how large the class was, or how good the other pupils in the class are in arithmetic. The statement of the third teacher, based upon even more refined evidence, tells us much more. We know, first, that the boy's achievement in arithmetic was measured by a standardized test. This generally means a good measure because a great deal of work is done on standardized tests to make them accurate and valid. The statement tells us furthermore that of 100 boys selected at random from his standard this boy's arithmetic score would rank him 13th from the top or 87th from the bottom of the group.

How is Evidence of Educational Achievement Procured?

Just as evidence in physical and biological science is based upon observations in the form of measurements so is much of the evidence that is used by teachers who experiment a result of measurement. A considerable amount of any teacher's time as he teaches is normally devoted to seeking evidence as to whether or not he has taught what he has been trying to teach. When a teacher gives a test he does so, primarily, to get evidence. When he asks a pupil a question in class he is getting evidence. When he observes the pupils at play on the school grounds to see if they are behaving themselves he is getting evidence.

As has been illustrated many times in earlier chapters, classroom experimentation almost always involves getting evidence before the experiment starts, and after it has been completed, in order to find out what consequences the experiment had. This evidence must be "quantified" and of good quality if it is to provide a sound basis for decisions and judgment. The teacher who experimented to improve the neatness of his pupils and reported that they were not very neat

before the experiment but were much neater afterwards did not say much of value. The reason was that his "before" and "after" estimates of neatness were so vague. Their vagueness resulted in part from the fact that the estimates were not in the form of understandable quantities. We do not know what he meant by "not very neat before." We do not know what he meant by "much neater afterwards."

Our ideas as to the results of this experiment would be much clearer if the teacher had made a statement like this: "During two days before I started my experiment to improve neatness I observed rather systematically all instances of sloppy papers, sloppy notebooks, and untidy desks. During these two days I noticed twenty six such instances. After my experiment I observed for two days in exactly the same way. During these two days after the experiment I observed only eight instances."

The progress of science has been said to be pictured in the progress of scientific measurement. Atomic physics advances every time a better method is developed for measuring the movements of protons, neutrons or whatever other elements the atom may include. The same dependence for development on measurement is illustrated in the case of technology. Almost anything that is mass produced in a factory must have its dimensions, its weight, volume or what not, carefully controlled and the basis for control is precise measurement.

In a similar way it might be said that one indication of the progress of education is progress in the direction of improved educational measurements. This should not be difficult to understand. In the last analysis, no teacher knows whether or not he is teaching unless he gets some evidence. The better this evidence can be the sounder is the conclusion the teacher reaches about his effectiveness. There was no research or experimentation on education prior to the development. There was a great deal of speculation, some of it enlightened, but no research.

In this connection, there is much reason to believe that teachers teach best those lessons that they can know they are teaching. In other words, if a teacher can get evidence as to whether or not his teaching is effective this enables him to teach better. The best teaching is probably of routine skills or habits like spelling, arithmetic facts, names and dates in history, and so on. One reason for this is that measurement to find out whether such things have been learned is quite easy. We do less well teaching pupils to think (See Chapter VIII). One reason is that we have not developed good ways of measuring thinking capacity. We probably do least well as teachers when we try to change pupils' attitudes or values. Again, one important reason for this is that we have made relatively little progress developing practical ways to measure change in attitudes and values (See Chapter IX).

In talking about educational measurements it is often said that many of the things the teacher is trying to do are so subtle or their consequences so long delayed as to make measurement impossible. We believe it would be more realistic to say that much that the teacher is trying to do is exceedingly difficult to measure *but not impossible*. Prof. E. L. Thorndike is probably the best known of the early educational psychologists. In his research he concerned himself continuously with problems of measurement. He is alleged to have made this statement, "Every thing that exists, exists in some amount. Anything that exists in amount can be measured." What do you think of this contention? What does "amount" mean?

What is the Place of Evidence in Educational Research?

As the reader has already learned, evidence is sought and used in connection with many aspects of the problem solving process. For a teacher to define a problem, for example, requires evidence to determine first, whether or not the problem as stated actually exists, and secondly, its extent. What kind of evidence would you want in order to better define the problems implied in each of the quoted statements below?

1. "I've not been successful teaching my pupils to use science principles in understanding everyday biological and physical events." (8th Standard, General Science teacher.)
2. "My pupils are unable to remember names and dates in history for very long. I'd like to be able to teach such facts so that they are remembered for a long time." (10th Standard History Teacher.)
3. "My pupils can repeat sound arguments for cleanliness in connection with eating but when they eat you would think they had never heard of cleanliness. I'd like to change that." (4th Standard Teacher.)

The teacher who is doing experimentation and reaches the point where he is concerned with problem diagnosis must often seek more evidence. Frequently, a particular diagnosis is a conjecture. Before an experiment is undertaken to eliminate or reduce the influence of some conjectured reason for an undesirable situation the conjecture must be tested by getting evidence. What evidence would you want in order to determine whether or not the following statements about reasons for a classroom problem are true?

1. My pupils are afraid of mathematics. That is why they do poorly. (6th Standard Teacher.)
2. The class is so large that the pupils in the rear cannot see the demonstrations. (11th Standard Chemistry teacher.)
3. There is almost no interest in kitchen gardening because the children all come from urban homes. (5th Standard teacher in a Basic school.)

We have said before but we repeat : *If the problem is poorly diagnosed, if the real reasons for its existence are not discovered, whatever is done to remedy the situation will be successful only by chance.* One of the great limitations of teachers who have not learned to base their judgments on evidence is the dogmatic statements they make about the reasons for unsatisfactory school situations.

Almost without exception classroom experimentation involves getting evidence before and after some change in teaching methods or materials. It is on the basis of a comparison of evidence obtained at these two times that the teacher concludes whether or not the new methods or materials he tried in his experiment have been successful. In most cases the same procedures and tools that were used to get evidence or facts to define the scope of the problem initially can be used again after the experiment is completed. Devising instruments for getting evidence calls for a great amount of teacher ingenuity. For this reason we are devoting the next three chapters to a discussion of what can be done to get better evidence about academic achievement, about attitudes, and about overt behaviour.

What are the Criteria of Good Evidence?

Evidence is good or bad to the degree that it can be effectively used for the particular purpose for which it is sought. For example, a person comes into a cottage and is asked "Is it very warm outside?" His response is, "No, not very warm." What he is doing, is reporting his judgment based upon the evidence of his senses of the outdoor temperature. This evidence is very approximate. It is not in quantitative form and is casual. Despite these inadequacies, the simple response often fulfils the purpose for which it was sought. When this happens, criticisms of the quality of the evidence are usually irrelevant.

Another question about the outside temperature might need to be answered by reporting more refined evidence. A farmer might say, for example, "I'd hate to have those seedlings freeze. How cold did it get last night?" If some one were to say "Quite cold," this evidence would not help the farmer. If the answer was : "The coldest was 4 degrees above zero centigrade", his problem would be taken care of. In other words the evidence in the form reported made it possible for the farmer to reach a conclusion about the freezing of his seedling.

The remainder of this chapter discusses the characteristics of evidence or of facts or data which are generally considered to make them more useful.

Qualification : The development of all languages has resulted in many words used to convey ideas about quantity. For example :

The Ganges flows slowly.

The Jet aeroplane came down on the landing strip *slowly*.
 The bed was *very* soft.
 Gold is a *very* soft metal.
 His fever was *high*.
 The boy made a *rather* low mark in arithmetic.

Few primary teachers have professional training.

Each of the underlined words is intended to give an approximate notion of quantity. The meaning of the quantity word must be interpreted in relation to its context. To understand what is said about the speed of flow of the Ganges requires some general idea about the speed of flow of rivers in general and the Ganges in particular. The word "slowly" implies quite different actual rates of movement when used in reference to the Ganges or to an aeroplane coming in to land. Similarly the words "very soft" imply quite different quantities of "softness" when applied to a bed or to gold.

Before reading any further, try to render each of the above statements of approximate quantities in more exact quantitative form. After you have done so, *but not before*, turn this page upside down and read how the authors would do it.

In India about 65% of primary teachers have had professional training.
 The boys mark on the arithmetic test placed him 35th from the top in a class of 40.
 His fever increased his bodily temperature by 5 degrees Fahrenheit.
 Gold ranks 18th among 20 metals in hardness.
 The jet aeroplane hit the landing strip at about 160 miles per hour.
 The average rate of flow of the Ganges is three miles per hour.

There can be little if any useful experimentation by teachers unless the situation that dissatisfies them and which leads to experimentation can be described in quantitative units of some sort. If this is not done dependable inferences about the success or failure of the experiment are not possible.

Reliability : A question that is almost always asked about evidence or data or observations is : "Are they reliable?" The term has an especial meaning to research specialists but the more popular interpretation of "reliable" is not far from the more technical meaning. Evidence is reliable if it is accurate. A measurement is reliable if two or more people doing the measuring would get approximately the same results. For example, using a ruler to measure the height of a school boy would result in a quite reliable measure of his height. Several different people measuring the height of the same boy would get almost exactly the same number of inches. Measuring the dimensions of a room with steel tape measure would yield a more reliable indication of its width and length than "pacing it off."

Educational evidence or data resulting from measurement can be of all degrees of reliability. A carefully standardized test of arithmetic problem solving ability would be highly reliable. It would yield the same score for a particular pupil or group of pupils no matter who gave the test. The mark or score given to a pupil by a paper marker on the basis of his answer to this question would be quite unreliable: "Discuss the most significant events leading up to the founding of the Congress Party." The proof of this unreliability would be the variation in the marks given to this boy's answer to the question if several teachers were to mark the same paper.

The unreliability of the scores given by paper markers to students' essay examination papers rarely comes to light. The reason is that, except in very rare cases, the paper is marked by only one person. The reliability of this single score is assumed.

Which member of the following pairs of evidence getting procedures is, in your judgment, apt to result in more reliable evidence? Why?

Measuring the width and length of a room with a ruler. Measuring the length and width of a room with a yardstick.

Measuring intelligence with a standardized test. Measuring intelligence by using teachers' judgments of pupils' intelligence.

Measuring spelling ability with a list of 30 words. Measuring spelling ability with a list of 60 words.

If evidence is greatly lacking in reliability, the decisions and conclusions based upon it are bound to be poor ones. There are several ways to find out how reliable evidence is. One of the most often used is to have another person repeat the observations or render the same judgments. For example, let us assume that an experiment is undertaken to improve the cleanliness of pupils and cleanliness is "measured" by teachers' judgments. One hundred and forty boys are involved. Each boy is to be rated A, B, C, D or E in cleanliness and each of these letter ratings is carefully defined. Basing your judgment on the table below would you say the ratings are satisfactorily reliable? Why?

Category of cleanliness	Boys put in Respective Categories by 1st teacher		No. of Same boys put in Categories by 2nd teacher	Approximate percent put in same category by two teachers
Percent				
A	..	12	10	85%
B	..	30	28	92%
C	..	36	33	94%
D	..	47	42	89%
E	..	15	13	87%
Total	..	140	126	90%

Our judgment would be that the ratings by the first teacher are quite reliable or accurate. The reason is that a second teacher making independent ratings of the cleanliness of the same children, agreed in about 90 per cent of the cases. This agreement is sufficiently close to give considerable confidence in the accuracy or reliability of the ratings.

Validity: Most research specialists in education feel that the validity of evidence or data is of basic importance. Evidence, or educational measurements, or test scores, or ratings, or judgments are valid to the degree they describe what it is claimed they describe. For example, if a teacher's judgment of a child's intelligence is also, in part, a judgment of his language ability or disciplinary behaviour in school, the judgment lacks validity. If a pupil's mark on an examination intended to measure his knowledge of Indian history is influenced by the quality of his penmanship, the mark is lacking in validity. If a pupil copies from his neighbour on a spelling test his mark on the test is invalid because it is influenced by the spelling ability of the boy's neighbour. When we want to describe or try to determine the degree to which a particular assessment, whatever its nature, is valid, we generally compare the assessments with some known and accepted criteria. If, for example, a test is developed to measure honesty, its validity is the degree to which a pupil's score in the test is indicative of his actual honesty in real life situations.

Conclusions .

In concluding this chapter on evidence and its importance we wish to repeat some points that have been made. The fact that teaching is a practical activity, and that its success depends upon the quality of the teacher's decisions means inevitably that the decisions to be sound must be based upon good evidence. Getting evidence is a critical aspect of all educational research. But the evidence must be good evidence. It must be quantitative and as reliable and valid as possible. When teachers have had some experience in classroom experimentation they start paying explicit attention to the reliability and validity of their evidence.

We want to repeat, too, that there is much truth in Thorndike's statement that whatever exists, exists in some amount; and that whatever exists in amount can be measured. At any particular time a teacher conducting an experiment may be quite dissatisfied with the quality of the evidence on which his conclusions are based. If he is a good scientist, however, he knows that it is always possible to get better evidence in the future,—better evidence than that was used in the past.

CHAPTER VIII

HOW TO GET EVIDENCE ON ACADEMIC ACHIEVEMENT?

Many teachers experiment to improve their teaching of subject matter content. They want to do a better job of teaching science or history of literature or language. This is true of teachers at all levels and in all subjects. There are, of course, many reasons for teachers wanting to improve this kind of instruction. One of them is the nature of the external examinations. Another reason is that the great majority of syllabuses place major emphasis on subject matter content. Some teachers seem to think that all they are supposed to do is to see to it that their pupils learn subject matter.

The evidence teachers use to find out whether or not they have taught the subject matter content they have been trying to teach is quite often lacking in reliability. One reason for this is that the tests used are of the essay or discussion type. It is very difficult to mark such test papers accurately or reliably (See Chapter VII, p. 52-54). Six different teachers marking the same paper would give it quite different marks. This has been demonstrated again and again. The reader has already learned that it is impossible, especially when experimenting, to draw sound inferences or develop dependable conclusions on the basis of unreliable evidence.

In this chapter we emphasize ways of getting evidence about academic achievement that are relatively objective. We first analyze what is generally called "academic achievement" into its several elements. We then illustrate in the case of each kind of academic achievement, better ways of getting evidence that will describe the amount that students have learned.

What Does Teaching Subject-Matter Mean?

The teachers of what have come to be called the "content subjects" attempt to achieve three somewhat different kinds of objectives. These objectives are related to the findings of psychologists regarding "levels of learning". One level is represented by habits. A habit is a response, verbal or otherwise, that follows almost immediately after the stimulus with which it has been associated. This level, so far as content subjects are concerned, is best described by what students do when they memorize. Subject-matter that has been memorized can be reproduced, without much thought or reflection, when the proper stimulus is presented. For example, a teacher of Indian history asks the question, "What was the year in which India got her freedom?" He expects an immediate answer "1947". If this fact has been memorized, the pupils answer the question without hesitation. They do not need to "figure anything out" in order to respond. Similarly, a pupil learns to spell many words almost automatically when there

is need to do so. Most pupils by the time they have finished the Standard V have memorized the multiplication table up through 20×20 ,

A second level of learning of subject matter, and a somewhat higher level, results in *understanding*. By higher we mean that more complex mental processes are involved. A pupil can, of course, memorize subject matter without understanding it. This goes on in many schools continuously. Children "commit to memory" long passages from their text-books or their teachers' lectures but are unable to explain the meaning of what they have memorized. They have little understanding of it.

When something is understood, pupils can answer questions about it. They can interpret it. They can paraphrase it. They can pick out the central idea. They can make wise inferences from what they have learned. A high school pupil, for example, indicates some understanding of the relationship between population increase in India and increase in the production of foodstuffs for the past 10 years when he says, "The production of food grains has increased at a rate of about 3% a year, but this is not enough. Many of our people now are not adequately fed, and the increase in population is approximately 2% a year." Of course, these two sentences could have been memorized without understanding them but one or two questions would quickly indicate whether or not this was the case.

A third kind of purpose that the best teachers of the content subjects try to achieve is to enable their students to *use* their understanding of history, chemistry, physics, biology, agriculture, or whatnot, as they try to understand or solve problems that they have not met before. This is believed by many thoughtful educationists to be the ultimate purpose of formal education. It is to equip people with knowledge *to be used*. The only real justification for knowledge is to enable people to cope with the political and economic and personal problems with which they must deal.

A great deal of research has been conducted of the extent to which pupils remember the facts, or the understandings, or the information they have used to solve problems. This research indicates that whenever pupils learn information so that they can use it in coping with a problem they remember what they have learned for a longer time. Examinations given to pupils 12 to 24 months after they have finished studying certain subject matter content indicate that the memorized facts disappear first. *The general ideas that result from understanding last longer. The principles and information pupils have learned to use in solving problems last longest.

As we already have implied there is much reason to believe that in many schools the greatest emphasis in teaching is on the first, or lowest level of learning. Here teachers spend a great amount of time getting boys and girls to memorize facts, names, dates, principles, and

similar items of information so that they can give the right answer immediately to the teachers' questions. In most schools less time is devoted to increasing the pupils' command of knowledge that they genuinely understand and can interpret. A minimum of time too often is spent in trying to help boys and girls find out how to use the subject matter they have learned in order to solve important problems.

Getting evidence of the degree to which pupils have acquired factual information or understanding or the ability to apply what they know is always made easier when teachers are able to define quite exactly what they mean in each instance. If a teacher, for example, means by teaching factual information that his pupils should be able to answer appropriate questions requiring the facts immediately, this gives him a good idea as to the kind of test questions to use to get evidence of the success of his teaching. If he defines understanding as meaning to paraphrase, to pick out the central idea, to explain, or to make correct inferences, each of these definitions helps him in the construction of items to get evidence on the degree to which his pupils can do these things.

Getting Evidence about Knowledge of Facts

Teachers who are conducting research or experimenting to improve their ability to teach facts or other memorized information find that getting rather reliable evidence of the results of such teaching is not too difficult. Whether or not a pupil has learned facts or information of a factual nature can be measured in either of two ways. One way is to find out whether or not he can recognize correct facts,—that is, facts that should be given in response to specific questions. An illustration of recognizing the correct fact would be a pupil's underlining of the 3rd choice in the following multiple choice question :

Underline the name of India's present Minister of Defence :

1. Desai
2. Ramanujan
3. Menon
4. Shastri

The pupil may not have been able to *recall* the name Menon but he could *recognize* it as correct.

The second general method of getting evidence as to whether or not pupils have acquired knowledge in the sense of remembering facts, names, principles or other items of information is to find out whether or not they can *recall* them. A question similar to the above that requires recall might be worded as follows : "Who is the present Minister of Defence in India ?"

Sometimes recognition is important. Sometimes recall is important. Research studies indicate that there is a close relationship (high coefficient of correlation—see Chapter XI) between the ability to recognize facts and the ability to recall them. Measurement of recognition is often easier than measurement of recall and given the close relationship between the two, recognition tests might be preferred.

One of the commonly used “objective” methods of getting evidence about a pupil’s ability to recognize rather than recall information is the true-false or yes-no question. The word “objective” used in this sense means a test question the response to which would generally be agreed on by a group of teachers as either correct or wrong. An illustration of the true-false type of objective question is given below :

To the left of each of the numbered items write the letter *T* if you think the statement is true or the letter *F* if you think the statement is false :

1. Rust results from iron combining with oxygen.
2. Adding sodium hydroxide to hydrochloric acid produces ordinary table salt.
3. A BUNSEN burner is used to make coke.
4. Yellow flame is usually hotter than blue flame.

Formulating true-false or yes-no questions that provide good evidence of achievement requires care. It has been said that objective questions require much time and skill to *formulate* but little time or skill to *mark*. Essay questions require less time to formulate but a great deal of time to mark.

There are certain general rules that a teacher should try to observe when preparing items of the true-false variety. Some of these rules are given below :

1. Unless the purpose in testing is to find out whether or not pupils can understand complex language, the wording of the true-false items should be straight-forward and simple. For example:

Poor: The protagonists of atomic bomb explosions for testing purposes are generally militaristic.

Better : People who favour atomic bomb explosions for testing purposes tend to be warlike.

2. Verbatim statements should not be taken from text-books, or lectures and used as true-false items. This practice is bad because it encourages boys and girls to memorize the

text or to memorize the lecture without trying to understand.

3. Trick questions are to be avoided. Questions that are tricky are more apt to provide evidence about the pupils' suspiciousness or his intelligence than about his knowledge of subject-matter. For examples of true-false items:

Poor: India won her freedom in the 47th year of the 19th century.

Better: India achieved freedom in the year 1947.

The poor illustration would represent a trick item for many students because they are quite apt to confuse the expression "19th century" with years numbered from 1900 on. If the purpose of the item were to measure the ability of the students to differentiate between these two expressions it would not be a trick item. It would, however, be a "double barreled" item (*see* 6 below).

4. Statements should be clear and unambiguous. The most common criticisms made of true-false or yes-no test items is that they lack clarity and unity. This leads to long and generally fruitless arguments as to whether T or F is the correct response. For example:

Poor: People in India favour old age pensions.

Better: A large majority of the Congress Party favours giving pensions to disabled persons who are unable to work and are over 60 years of age.

The first item is so vague that it could be responded to with a T or a F. The word "people" is undefined, "old age" is very ambiguous. The second illustration is clearer.

5. "Specific determiners" should be avoided. "Specific determiners" are words like never, always, invariably, usually, sometimes, etc. The extreme words almost always appear in a true-false item when the correct answer is false. The more moderate words like usually or sometimes, appear in statements that are generally true. Pupils soon pick up these "cues" and are able to answer correctly without "knowing" the information.
6. Avoid the use of double barreled items. These are items that include more than one idea. This practice is especially to be avoided if one of the ideas in the true-false item is correct. For example:

Poor: Gold is not the heaviest metal but it is the most precious.

Better : Make two items :

- (a) Gold is the heaviest metal.
- (b) Gold is the most precious metal.

The poor illustration is partly true and partly false. This is confusing. In the better illustration, both items are clearly false.

The "multiple choice" kind of objective test item is probably familiar to many teachers. An illustration might be :

"Place a tick mark (\checkmark) before the one correct choice,—the one that makes a true sentence :

When equal parts of yellow and blue are combined the resulting colour is :

- () 1. brown
- () 2. green
- () 3. orange
- () 4. purple

This type is really four true-false items with the same introductory phrase. A pupil must, in effect, read the introduction four times, once with each of the four possible choices, and decide which statements are true and which false. In this case "green" is the correct choice.

Another kind of test question that makes it possible to get rather objective evidence about the factual information pupils can recognize rather than recall is known as the "matching item." In general, these items include two columns. One of them, for example, might be a column of names of famous men, the other, a column of events or activities with which those individual men have been associated. The pupil is to indicate which name goes with which event or activity.

An illustration of the matching items is given in Chapter IV on page 24. Turn back and re-examine this question.

Is there factual information you are teaching that would lend itself to the "matching" item when you want evidence about your pupils' learning? Matching item has one advantage over true-false in that here it is more difficult to guess the correct answer. To make guessing harder one column usually will have more items in it than the other.

When a teacher experiments to improve his methods of teaching factual information, he may want to get evidence of the ability of his pupils to *recall* rather than *recognize* what they have learned. While as we have said, the relationship between the ability to recognize and the ability to recall is close, recall is harder. This means that on a

100 item *recall* test pupils would get lower scores than on a 100 item *recognition* test covering the same information.

Two common types of objective items are used to measure recall. One is the short answer test, with which most teachers are familiar. The other is the completion test. Illustrations of rather objective short answer items are given below :

1. Name the major bodies of water that wash the shores of India.
2. What mountains separate India from China?
3. Name the capital cities of these Indian States : Assam, Bihar, Gujarat, Kerala, Madhya Pradesh, Uttar Pradesh, Punjab.

The second kind of item that can be used to measure the recall of *factual* information is called the "completion" test. This is a sentence with certain critical words omitted which the pupils must supply. Illustrations are given below :

1. A high bodily _____ means fever. -(temperature)
2. Blood is pumped through the arteries and _____ by the _____. (veins; heart)
3. The _____ gland does for the body what the draft does for a stove. (thyroid)
4. The cerebrum is protected from damage by the _____. (skull)

Many of the general principles that were given in connection with the discussion of true-false questions are helpful in constructing better completion items.

Economical Ways of Getting Evidence about Memorized Information

It is, of course, possible for teachers to dictate true-false or yes-no items and have pupils write on their slates or on a small strip of paper the answers. If the teacher is concerned because students may not give original answers but those of their neighbours he can divide his class into A and B rows and have all A rows answer one half of the questions and all B rows the other half. A matching question can be put on the chalkboard and all the pupils need to do is write on their slates or on a small piece of paper the proper sequence of the matched items.

One advantage in "short answer" items is that they can be dictated and the pupils need write on their slates or on slips of papers only the number of the question and what they consider to be the correct response.

Getting Evidence on Understanding

It is, of course, exceedingly important for pupils to understand the subject-matter they are learning. Every good teacher would admit this but the sad fact remains that in many classes the teachers appear to be satisfied if pupils are able to repeat, at the proper time, information they have committed to memory. Understanding subject-matter may have the following among other, meanings :

1. Pupils can reword what they have learned. They can paraphrase it. They can state it in their own words.
2. Pupils can pick out from what they have read or heard the central ideas.
3. Pupils can make intelligent inferences from information they have learned.
4. Pupils can answer questions about the meaning of what they have learned.

Some teachers may want to experiment in order to improve their pupils' understanding of oral speech. We do too little to train pupils better to understand what is said to them in lectures or other ways of presenting information orally. In order to get evidence on his pupils' understanding of speech a teacher, for example, might read this paragraph from a textbook :

"Most of the people of India live in villages. Villages are here defined as habitations that include less than 5000 people. If the diet and health and happiness of Indians are to be improved, changes must be brought about in the way villagers live, the food they eat, the water they drink, the crops they raise, the way they market their surplus grains, the way they spend and save their money."

After reading this paragraph, the teacher would say to his pupils, "Which of the following four ideas is the main idea in the paragraph? Write the number of the most important idea on your slate." He would then read slowly :

1. Most Indians live in villages.
2. Villages are places where fewer than 5000 people live.
3. The conditions in rural India are worse than in urban India.
4. Changing village life is very important if India is to be improved.

After he had finished reading these alternatives the pupils would write down on their slates or on a slip of paper either 1, 2, 3 or 4. The same procedures could be used for say fifteen or twenty paragraphs. Each pupil's slate or strip of paper with numbers on it would

then be collected and the number of correct "main ideas" recorded. Some pupils in a class would make few if any mistakes. Others would be unable to identify the main idea very often.

If each of the pupils has a text book the teacher can in a similar way get evidence on the degree to which his pupils understand what they have read. He can, for example, have them read at their places certain paragraphs from the textbook. After each paragraph has been finished the teacher can read out a few true-false or other kinds of objective questions to measure their understanding. The pupils can write down the number of the teacher's question followed by a T for true or F for false.

If the school has some audio-visual equipment it is possible to use an epidiascope or a 35 Mm. projector to put on a screen before all children some materials to be read followed by questions in order to get evidence as to whether or not they understand.

The reader will note that these illustrations are intended to put a minimum premium upon the ability of pupils to *remember* information and emphasis on their ability to *interpret* or *understand* what they have learned. Figuring out creative ways to get evidence on the understanding of subject-matter makes a great appeal to some teachers. Doing this not only makes it possible to conduct some interesting experiments on ways and means of improving teaching for understanding, but it has also an additional value, that pupils are almost always intrigued and motivated by opportunities to show how much they have understood.

Evidence on the Ability to Use Subject-Matter

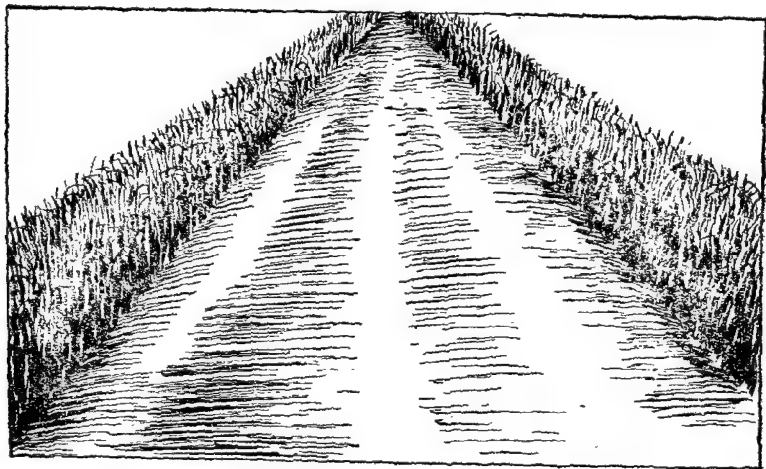
Probably the most important lessons teachers can teach, in connection with the conventional subject-matter fields, results in their pupils being able to *use* what they have learned in dealing with problems they have not met before. Just as the memorization of factual information does not mean that a pupil understands what he memorizes, so does the understanding of information give no assurance that it will or can be used in dealing with a practical problem. One of the authors knows a college graduate who studied science including physics and electricity. He seemed to understand a great deal about electric current and magnetism but he was completely baffled by the request to fix a broken door bell.

An illustration of an ingenious teacher's attempts to get evidence on the ability of his pupils to *use* information in solving a problem is the following case involving a teacher of agriculture. He knew that his pupils, both from instruction and their general experience, knew these facts:

1. The wind in their vicinity almost always blew from the south.

2. All improved roads in the area were of crushed limestone.
3. Bullock carts and trucks using the road created a great deal of rock dust.
4. The soil in the vicinity was rather sour because of poor drainage and other factors.
5. Hay grown in the area does best in sweet soil.

The teacher wanted to know whether or not the pupils could put these and other facts together in order to solve a problem. Consequently, he put this rough sketch on the board.



He then made this oral explanation of the drawing. The road was an improved road in the vicinity of the pupils' homes. It runs east and west. The hay on the south side of the road is quite short and on the north side of the road it was more healthy and vigorous and tall. It became less healthy and vigorous and tall the further it got from the road. He then asked "How would you explain this condition of the hay?"

Many of the pupils were completely puzzled. They could not put together and use facts that they knew in order to solve the problem. A few of the pupils, after some time were able to say something like this: "If the road runs east and west that means that the wind blows across it from the south. This blows the dust on the ground on the north side of the road. The further the distance from the road, the lighter the dusting. Because the road is made of crushed limestone much of the dirt is limestone dust. The soil is sour or acidic and the limestone sweetens it but the sweetening is decreased as the distance from the road increases. The hay does best in sweet soil, consequently, it should be highest near the road on the north side and would get shorter as the distance from the road increased."

Because of the importance in many kinds of classroom experiments of getting evidence on the ability of pupils to use information in the solution of a problem, teachers who want to improve this kind of teaching deserve a great deal of encouragement. Getting evidence on the ability to use information, however, is not easy. We are giving below some illustrations of rather ingenious attempts to measure this ability :

1. A teacher produces 10 maps each of increasing complexity. Each map, if properly read, would take a pupil to a certain place where he would write his initials to show he had been there. These maps were given to the boys and girls one at a time in order to get evidence as to whether or not they had learned enough about reading maps to be able to use a map to get some place.
2. A teacher passes round the class ten hanks of yarn of different counts and asks each pupil to ascertain the count of each hank as well as its strength. He thus ensures that the pupils can use the arithmetic involved in testing the quality of yarn.
3. A teacher decides to start a cooperative Store for a class who is taught accounting procedure. The items are listed, prices ascertained and sales-price determined—all this is done by the pupils. A ledger is devised wherein accounts are maintained by the pupils in turn. The class teacher thus ensures that through the project the class is enabled to use in actual situation what they have learnt and the actual day-to-day performance of the pupils will be the test of the degree to which they have understood the accounting procedure.

The teacher who is experimenting and is trying to get evidence before and after the experiment to measure its effects so far as learning or understanding or using information is concerned should keep in mind one important fact. The longer the test used to get the evidence the more reliable it is. A true-false test or completion or problem solving test of 50 items gives more reliable evidence of what has been learned in a certain field than would a test of 20 similar items.

CHAPTER IX

WHAT ARE ATTITUDES AND HOW CAN THEY BE MEASURED?

Teachers in all kinds of schools and at every grade level are interested in improving their pupils' attitudes. Many of the most serious classroom problems are the results of undesirable pupil attitudes. Conscientious teachers often want to experiment to bring about improvement in their pupils' attitudes towards :

1. Punctuality in submitting homework assignments;
2. Regularity in school attendance;
3. Personal cleanliness;
4. Neatness in written work;
5. Telling the truth under all circumstances;
6. Working with their hands;
7. Other communal groups in the class;
8. Other national groups.

This chapter is written to help teachers whose research or experimentation is undertaken to improve attitudes. Improving attitudes is, of course, one aspect of character training. We first define what we mean when we use words like attitude and values. We then describe some rather simple ways to measure attitudes. Finally, we comment on a few of the factors which, according to psychologists, influence the development of attitudes and values.

What is an Attitude?

An attitude is a tendency or disposition to react positively or negatively towards something. The 'something' to which the attitude is attached is its referent. The referent may be :

1. A person : "He had a very antagonistic attitude towards his teacher."
2. A group : "His feelings about his classmates were generally warm and friendly."
3. Something material : "He worshipped money."
4. Ideas : "He liked history the best."
5. A practice : "He argued day and night for compulsory and free education."
6. An institution : "His suspicions of universities were always with him."

Each of these illustrations reveals two things: (1) the referent of the attitude,—a teacher, classmates, money, history, compulsory and free education, universities, and (2) whether the attitude was positive or negative, favorable or unfavorable, sympathetic or antagonistic. This latter can be called the attitude's "valence", a word borrowed from physical science. Each attitude has a positive (+) or negative (−) valence in relation to its referent. If the valence of an attitude is positive a person wants to support the referent, be in its presence, defend it, admire it, or be well thought of by it, should it be a person. If the valence is negative, his desires are just the opposite.

Not only do attitudes have *valence*, not only are they indicative of positive or negative behaviour towards a referent, but they also exist in various degrees of strength. One boy may be mildly interested in education, another quite interested, and a third thinks of little else. In each case the valence of the attitude towards education would be positive, but the effort and sacrifice the three boys would put forth to get more education would vary appreciably.

Human beings are continuously forming positive or negative attitudes towards the persons, groups, ideas, practices, or material objects which come within their field of experience. Man is often said to be "an inveterate evaluator." Our reactions are rarely strictly neutral or indifferent. We tend to like or dislike almost everything we come in contact with. We are either attracted or repelled, in greater or lesser degree.

What is a Value?—An Aversion?

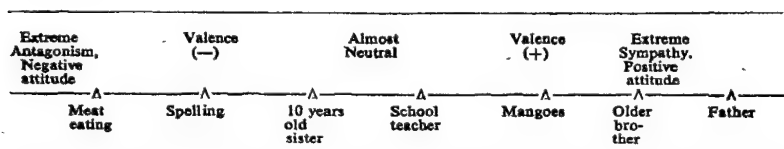
A person's values are the referents towards which he has developed positive attitudes. This means that values are as various in their nature as are referents. We can value a person, a group of people, an idea, a material thing, an institution, or a practice. A pupil who has a positive attitude towards his teacher, values his teacher. He likes to be with his teacher and wants his respect. A pupil whose attitude towards God, and all that word means to him, is very favourable, has God as one of his values. He reveres his conception of God and is positively influenced by it.

An aversion is the opposite of a value. An aversion is a referent towards which a person has developed a negative or antagonistic attitude. This means that aversions can be as varied in nature as values. A pupil may regard manual work as an aversion. This means his attitude towards manual work is negative. He avoids manual work when he can. He dislikes it. If a pupil's attitude towards arithmetic is negative, arithmetic is an aversion. The pupil dislikes doing problems. He avoids arithmetic and everything connected with it as often as he can.

Sometimes one must choose among values, among referents towards which positive attitudes have been formed but which are incompatible. A school boy may have both a favourable attitude towards doing his homework and towards playing in the afternoon with his school-mates and going to bed early because he is tired. Whether he chooses to study or to play depends upon the relative strength of his positive attitudes towards these two referents. If on a particular afternoon the favourable attitude towards playing is stronger he will play, if he can. He may be sorry later.

In the course of time the attitude towards a particular referent may change. Sometimes the change is quite rapid. After fasting for three days the favourable attitude towards food is very strong. Once food is eaten and the appetite satisfied the strength of the attitude is less. It may even change its valence temporarily. What was once a value becomes an aversion. Other attitudes change, if at all, very slowly. Most people maintain strong favourable attitudes towards their own families for a life time.

In thinking about attitudes it is sometimes helpful to use a diagram that is called a "value-aversion continuum." On the continuum, or scale, referents can be placed so as to indicate both their valence and their strength. Such a continuum is reproduced below to describe some of the values and aversions of an imaginary twelve year old boy :



This continuum is by no means complete, of course. This boy has positive or negative attitudes towards many referents other than those named on the scale. The ones appearing here, however, indicate that the boy has a very strong favourable attitude towards his father. He admires him. He is influenced by what his father says and wants. Should there be a conflict between what he might do to please his father or his older brother, this would trouble him because he has a strong favourable attitude towards both. Each of the two is an important value to him. In the case of conflict, however, he would probably choose to please his father.

The scale also indicates that spelling is an aversion to this boy. He dislikes it. He has a very strong negative attitude towards "meat eating."

How can Attitudes be measured?

The value-aversion continuum gives a suggestion about measuring attitudes, which always means measuring the valence and strength of

an attitude towards a particular referent. Sometimes we say of a pupil "He has fine attitudes." What we mean is that his attitudes towards certain referents generally considered desirable are positive and strong.

The best indication of a person's attitude towards a referent is what he does, his behaviour in relation to the referent. One can infer that a pupil's attitude towards punctuality is favourable if he is punctual. If he is usually punctual the positive attitude is fairly strong. If he is almost always punctual the positive attitude is very strong. It would probably not be desirable for him *always* to be punctual because being punctual sometimes requires a sacrifice of other values that are more important. Visiting a dying relative would be an example.

Observing what pupils do is the way most teachers learn about their attitudes towards various referents. This method of getting evidence about attitudes, however, is fraught with difficulties. One is that the pupil may know what referents his teacher wants him to value. So, in the teacher's presence, or when he thinks the teacher is watching, he behaves as if he too valued these referents. In the teacher's presence, for example, he criticizes other boys who are not neat. He "pretends" to have a positive attitude towards the referent "cleanliness". When the teacher is not around he makes fun of boys who are clean. His behaviour in the teacher's presence and under these circumstances is not indicative of his *real* attitude towards being neat and clean.

Another difficulty a teacher faces when he infers a pupil's attitude towards a referent from his behaviour is that what the teacher sees may not be a good *sample* of all the instances when his attitude is revealed. For example, a teacher may see a boy hit his brother. The teacher might conclude that the boy's attitude towards his brother is strongly antagonistic. Actually, 90% of the boy's behaviour in relation to his brother might be friendly. What the teacher observed was a misleading instance or sample of his behaviour.

Many classroom teachers have done research in order to improve their pupils' attitudes. Changing attitudes is not easy and this is probably a good thing. It would not be desirable if our values and aversions could be too easily changed by anyone who wanted to do so. If this were the case, we would be blown down by every wind of doctrine that came along and when we got up we would be facing in a new direction. People whose attitudes are changed too easily are often victims of propaganda. They are unpredictable and whimsical.

Some of the attitudes pupils have, however, clearly need changing. Even though doing so may be hard, teachers usually try. No teacher can know whether or not his efforts have been successful unless he gets some measure of the valence and strength of the attitude towards

its referent *before* and *after* his experiment intended to change the attitude. There are a number of ways to measure attitudes. Some of them are quite difficult and require specialized training that few teachers have had. Some are rather simple.

A Simple Attitude Scale

Probably the simplest "measurement" of an attitude results from requesting a pupil to put a tick mark on a scale to describe his own attitude towards some particular referent. For example, the teacher might put a scale on the blackboard and say to the pupils :

"Boys and girls have different attitudes towards getting to school on time (the referent in this case). Some of them try very hard to come before the last bell rings. They would miss their breakfast and run all the way from home rather than be late. Other pupils would go to some trouble to be on time but they would never give up breakfast. Still other pupils don't care a bit whether they are on time or not. I've put a scale on the board that you can use to describe your own personal attitude towards being at school on time. Look at the scale. (At this point the teacher would refer to the scale he had drawn on the blackboard which would have this general appearance) :

Scale to Measure Attitude towards Reaching School on Time

Do not care at all about being on time		Sometimes I care, sometimes I don't				Try very hard to be on time every day			
1	2	3	4	5	6	7	8	9	10

I want each of you to think where *you* are on this scale. If you don't care at all whether you're on time or not, you would be at 1 or 2. If you only rarely take any trouble to be on time you might be 3 or 4. (The teacher would go on giving the meaning of the various numbers on the scale. Then he would continue). Each of you will write on a small piece of paper a number to represent your own attitude towards coming to school on time. I will not ask you to put your name on this paper so be as honest as you can be. Do it now. (The teacher allows a little time, answers any questions, and then continues with the directions.) Now draw a circle around the number that describes *your* attitude. Turn the paper over and write down another number to represent the attitude of your best friend, towards coming to school on time. I do not want his name, just a number to describe his attitude. Put the number down and *do not* draw a circle around it. (Teacher allows some time, answers any questions, then collects papers.)

When this quite simple method of measuring attitudes is used the teacher has taken two precautions to increase the likelihood that each pupil honestly reports his attitude. First he made it clear that

he did not want names. He was only interested in the class average. This would make it easier for pupils having "bad" attitudes towards promptness to report them.

The second precaution was asking each pupil to report the attitude of his best friend without naming him. To report a "bad" attitude for an unnamed friend would be easier than to report a similar attitude for oneself. After all of the papers are handed in, the teacher might compute the average (See Chapter XI). What would you conclude from these averages?

Average scale value for each pupil's own attitude	..	..	..	8.8
Average scale value for friend's attitude	..	..	..	6.3

The discrepancy between these averages probably measures the pressure on each pupil, when reporting his own attitude, to make it conform to what he believes are the expectations of teachers. His report lacks *validity*. (See Chapter VII). In other words, it is not a very good measure of his attitude towards promptness because it is influenced by his desire to report what he thinks his teacher wants.

If a research minded teacher conducted an experiment to change and improve the attitudes of his pupils towards coming to school on time and measured attitudes "before" and "after" with these results, what would you conclude?

	Before Experiment	After Experiment
Average scale value for pupil's own attitude	8.8	9.1
Average scale value for friend's attitude	6.3	8.5

An Attitude Inventory

There is a somewhat more complicated method of measuring an attitude which some teachers may prefer to use. This more complicated method involves making an "attitude inventory." We are describing below each step in the process:

1. The teacher identifies a referent in relation to which he would like to change attitudes. For this illustration we assume the referent is "refugees". In his experiment the teacher intends to make his small contribution to better communal relations and understanding by trying to make his 7th class pupils' attitudes towards refugees more favourable.
2. To start making the "attitude towards refugees" inventory the teacher asks each pupil to talk to some other people about refugees and then write down four or five different sentences these other people have used that indicate how

they feel about refugees and their problems. The teacher might give some examples to make the assignment clear :

- (a) The refugees aren't any worse than other people.
 - (b) You can't trust anyone who is a refugee.
 - (c) After partition we get along fine in my town with people who have come from Pakistan as refugees.
3. The teacher collects all of these statements from his pupils and (a) edits them to improve the language and to make each statement clear and short and centering on a single idea, and (b) arranges them in numbered sequence.
 4. The teacher reads out, slowly, each statement giving its number. The pupil writes the number on his slate and after it a + if he thinks the statement represents a favourable attitude towards refugees and a- if he thinks it represents an unfavourable attitude. The pupils do not indicate their own attitudes. They just indicate whether or not the statement is favourable or unfavourable to refugees.
 5. The teacher, after going clear through the list, goes back and asks for a show of hands to find out how many of his pupils reacted to each item with a + and how many with a -. A statement is eliminated from the inventory unless there is at least 75% agreement by the pupils that it is either favourable (+) or unfavourable (-) to refugees. The statements on which there is this percent of agreement make up the "Attitude towards Refugee Inventory." If there are enough items or statements to put half of them, by chance, in Form A of the inventory and half in Form B, so much the better. There should be about 30 items in each form.

When the time comes to use the Inventory to measure the pupils' attitudes, in this illustration, towards refugees, the Inventory can either be cyclostyled or the items can be read out serially by the teacher. The pupils are asked to react to each statement as follows :

- with a + if the statement describes the pupil's attitude;
- with a ? if the pupil is not sure, or it represents his attitude sometimes;
- with a - if the statement *does not* represent his own personal attitude.

Marking or scoring the pupils' reaction is not difficult. For all statements that express a *favourable* attitude towards refugees a pupil's reaction of :

- + gives him 3 points
- ? gives him 2 points
- gives him 1 point

The scoring of the statement expressing a negative attitude is just the reverse. A mark against the statement of :

- + gives 1 point
- ? gives 2 points
- gives 3 points

A pupil making a high score has a favourable attitude towards refugees. If his score is low, his attitude is unfavourable. If there are 30 items in the inventory the maximum possible score is 3×30 or 90. The lowest score possible is 1×30 or 30.

Assume a teacher constructed this kind of inventory and measured his pupils' attitudes before and after trying to change them. If he got these average scores what would you conclude?

average score <i>before</i> experiment	75.6
average score <i>after</i> experiment	76.3

The reader should bear in mind that refugee was used as a referent only as an *illustration*. In actual practice an inventory could be constructed to measure attitude towards any referent.

How do Attitudes Develop and Change?

The process of attitude development is a complex one and social psychologists have written much about it. A point of view that has been helpful to the authors explains most attitudes as resulting from a process of association. For example, if a person already values a particular referent, say a great leader like Nehru, whatever Nehru seems to value will tend to take on value status for the person who admires him. A baby's mother is soon associated in the baby's experience with satisfying his hunger and relieving his pain. These conditions are valued so the mother, frequently associated with them, is valued "by association."

This book on research for teachers is no place to discuss at length the best way to bring about changes in the attitudes of pupils. Trying to do so by scolding and admonishing, however, is rarely successful. A wiser thing to do is to try to find out something about the pupils' *existing* value-aversion system and use it to teach him new values. Whatever referent a teacher wants his pupils to develop a positive attitude towards, to value, he will try to associate *in the pupils' mind*, with something they already value. Indiscipline in a school can often be improved by first identifying the pupil leaders, who are the boys and girls most valued by the other pupils, and concentrating on changing their attitudes first.

CHAPTER X

GETTING EVIDENCE ABOUT BEHAVIOUR

This is the third and final chapter that has to do with getting evidence. The reason evidence has been emphasized so much is that it is absolutely essential for research and experimentation. A teacher cannot know what the effects of his teaching innovations or experiments have been without getting evidence as to whether or not they have improved the learning of his pupils. Chapter VII had to do with getting evidence and data on academic achievement. A separate section in this chapter was devoted to measuring what has been memorized, what has been understood and whether or not what has been understood can actually be used in the solution of practical problems. Chapter IX had to do with getting evidence on attitudes or values. The nature of attitudes and values was briefly described but most of the chapter had to do with measuring attitudes.

This chapter, as its title indicates, deals with getting evidence about behaviour. We realize that, in a sense, the result of all education is some change in behaviour. We want, for example, to teach pupils to spell words differently and this means changing their "spelling" behaviour. When we teach history one of our aims is to have them respond differently to questions dealing with historical facts and this, too, represents a change in their behaviour. In this chapter, however, we are thinking of a somewhat different conception of behaviour. The behaviour we are talking about is in larger units. The way we are using the word "behaviour" will become clearer as we go along.

Many teachers experiment to try to discover better ways of influencing the behaviour of the pupils in the sense in which we are using the word. Many educationists insist that the influencing of overt behaviour is the ultimate purpose of education. They say it is what a man *does* that counts, not so much what he knows or believes. Knowledge is to be valued only if it is used to achieve good ends. Attitudes are important, primarily, because they indicate predispositions to behaviour.

In their experimentation to discover better ways to change behaviour, teacher may put to test a great variety of action hypotheses. All of them represent ways and means of teaching pupils as efficiently as possible to *do* some thing differently. Teachers experiment with different methods and materials to make pupils more friendly, to improve their punctuality, to develop in them cooperative behaviour to make pupils behave more democratically, to bring about better work habits, and to improve craft skills.

There are four somewhat different ways to get evidence on behaviour. The first is actually to observe what the pupil does. If a

teacher is trying to teach more friendly behaviour on the playground he might actually observe his pupils at play to see how they behave towards one another. A second method of getting evidence about friendliness would be to look at the consequences of this behaviour. For example, if a teacher is interested in improving the friendliness of his pupils he might measure its consequences before and after the experiment by asking his pupils to name the two classmates with whom they would choose to go on a picnic or to exchange confidences. The pupils who receive many choices probably do so because being chosen is a consequence of their friendly behaviour.

A third way to find out how a pupil behaves is to ask him to describe his own behaviour. If a teacher is interested in improving a pupil's study habits, for example, he might before and after his experiment, give him a study habits inventory like the one suggested below :

Study Habits Inventory

Each of the statements below describes the way a pupil might study. Please put a tick (\checkmark) in the brackets before each statement that describes the way *you* study :

- () 1. Skims an entire chapter to get the big ideas before reading carefully.
- () 2. Makes outline notes on what is studied.
- () 3. Looks up strange words in dictionary.
- () 4. Tries to illustrate from his own experience the points the author is making.
- () 5. Tries to memorize what he reads.
- () 6. Consults teacher on difficult points.

A final way of getting evidence about the behaviour of a pupil is to request opinions or judgments about him from other people who have come to know him well. If a teacher is experimenting to improve his pupils' cleanliness, he might, before and after the experimental programme, request persons who know his pupils well to give judgments about the cleanliness of each one. A simple rating scale like the one below might be used for this purpose.

Cleanliness Rating Scale

The names of the pupils in the VII class in this school are listed in the left hand column below. After each name is a scale divided into 5 units. Please put a tick mark (\checkmark) on the scale against each pupil to indicate your judgment of his cleanliness. Very dirty pupils should be ticked in the space numbered 1. Pupils of average

cleanliness should be ticked in the space marked 3. The most clean pupils should be ticked in the space marked 5, and so on.

Rating Scale

Pupil's Name	Very unclean		Average		Very clean
1. _____	1	2	3	4	5
2. _____	1	2	3	4	5
3. _____	1	2	3	4	5
etc.			etc.		

This scale would provide better evidence of cleanliness if there were included in the directions a carefully worked out definition of what the teacher meant by "cleanliness".

No one of these four methods of getting evidence about behaviour is best under all circumstances. Sometimes it is more convenient and desirable otherwise to get evidence on behaviour by directly observing it. At other times it is better to look at the *product* of behaviour. When getting evidence on tidiness in school work, for example, it is quite satisfactory to examine the *products* of tidiness in the form of the appearance of notebooks, papers, and desks. Sometimes the best evidence is in the form of self-reports. Such reports are most dependable if there is no reason for the pupil to report other than what he actually does. In still other situations, asking other persons who know the pupils to render judgments about their behaviour is best. This latter is, of course, an indirect way of getting other people to report opinions based upon their observations of the pupils behaviour and its products or consequences.

The behaviour that teachers get evidence about in connection with their experiments may be either one of two types that are relatively rather than absolutely different. One kind of behaviour has strong value implications. It might be said to be "value saturated." An illustration of this kind of behaviour would be honesty. Getting evidence on the degree to which pupils behave honestly is generally difficult. The reason is that when pupils know that they are observed by others or when they are asked to report or describe their own behaviour, they are under great pressure to behave or to describe behaviour which is consistent with what they know is expected of them.

The second kind of behaviour which teachers may desire to change does not have such clear value implications. An illustration would be the behaviour of a pupil as he spins or weaves. It is impossible for a child to spin or weave better than he can. True, when he knows he is being observed he may spin or weave more carefully but whatever he does represent skills he actually possesses. Spinning and weaving behaviour, however, are not completely different from honesty so far as getting dependable evidence is concerned. If a teacher gets evidence about his pupils' spinning or weaving behaviour by asking them to describe how they spin or weave (self-report) the pupils

might say they do better than they actually can. Similarly, as has been said, they might spin or weave when they know they are being observed much more carefully than they would when not under observation.

The above two paragraphs call attention indirectly to the seriousness of the validity problem (*see* Chapter VIII) when getting evidence about or measuring behaviour of the complex sort we are attending to in this chapter. Whatever can be done through taking precautions or applying ingenious methods to get evidence on the actual behaviour of the pupils rather than what they think they ought to do is, of course, highly advantageous.

In order to make clearer the four different methods a teacher might use to get evidence about behaviour we are using the next few pages to describe how interest in improving the financial honesty of pupils might lead a teacher to use various procedures to get evidence of the extent to which his pupils were financially honest.

Before giving attention to the procedures he might use, it is essential that the teacher must first define *carefully* what he means by financial honesty. He might give the expression an operational definition such as is summarized in the following statements :

A pupil is financially honest if

- (a) he tries to locate the owner when he finds money that obviously has been lost;
- (b) he returns the excess money when given too much change after making a purchase;
- (c) when money belonging to another person is left where it is exposed and presumably can be taken with no risk he will call to the owner's attention the fact that his money should be put away;
- (d) when he is offered for an article he owns far more than the replacement cost he does not accept this excessive amount of money;
- (e) when he borrows money and the lender leaves his village apparently for good he will try to get the money to him or give it to his family;
- (f) he handles another person's money in a business situation and refrains from taking it even under circumstances where detection seems highly improbable.

The authors do not think that the above definition of financial honesty is in any sense complete. The various items only illustrate the kind of thing the teacher must do before he is in a position to try to gather evidence by any of the methods we are describing under appropriate centre heads below.

Measuring Honest Behaviour by Observation

One thing the teacher might do is to try to observe the pupil in situations where financial honesty is involved. He could make these observations by being present when the pupil was dealing with money in the normal course of his life under circumstances where he might or might not be honest. This method of getting evidence about honesty is, as the reader immediately recognizes, fraught with many difficulties. Teachers have few opportunities to observe their pupils in situations where financial honesty or dishonesty might be demonstrated. If there is a cooperative store in the school a few pupils might be observed handling money but the circumstances would be so unusual as to result in evidence of questionable worth.

Another thing a teacher might do is to create some situations in the school that would seem lifelike and real to the pupils but would provide an opportunity to make observations of their behaviour so far as it reflects financial honesty. A coin might be left, for example, on the teacher's desk underneath one of his books. The teacher might be in the back of the room and ask a pupil to fetch the book. He would observe, unobtrusively, what the pupil did when he saw the coin. Another teacher might send a pupil with some small change in excess of what is necessary to repay a small debt to another teacher who would observe what the pupil did when he learned he had been given more money than was needed.

Measuring Behaviour by its Product or Consequences

The second method of getting evidence on behaviour, as the reader will remember, involved trying to observe some product or consequence of the behaviour in question. We are describing below a technique employed in one research study to determine whether or not pupils would take money under circumstances where they felt certain that they would not be detected. We are describing this illustration by reference to a series of actions which a teacher might take :

1. The teacher prepared and cyclostyled a number of arithmetic problems that involved the manipulation of coins in order to get the correct answer.
2. The teacher placed in each of 45 small cardboard boxes, one for each pupil, the same number of coins of different values. For example, had the study been conducted in India, there might have been 10 one nP pieces, 5 five nP pieces, 5 ten nP pieces, and 2 twenty-five nP pieces.
3. The teacher secretly marked the underside of the cover of each box to correspond with the pupil's desk position in the room. These markings were not visible to the pupils.

4. While the pupils were out of the room the teacher carefully distributed these boxes putting each of them on the pupils' desks so as to correspond with the secret markings. This made it possible for the teacher to know the name of each boy who handled the coins in each box.
5. When the boys came back in the room the teacher distributed the cyclostyled sheets of arithmetic problems and said:

"I would like to have you use the coins in the boxes on your desks in order to answer the problems on the cyclostyled sheet. As soon as you are finished let me have the cyclostyled sheets with your answers on them. Also put the coins back in the box and place the box in this basket on the floor by my desk."

6. The teacher sits in the front of the room and waits while the pupils handle the coins to solve the problems. He pays little attention to what they are doing. When they have finished they put the box, presumably with all the coins in it, in the basket by the teacher's desk, hand the teacher the cyclostyled arithmetic questions, and return to their seats.
7. The teacher announces he will mark the papers and return them next day. The class proceeds with its lessons.
8. When the pupils have left school the teacher quickly marks the cyclostyled papers and gets them ready to return to the pupils. These papers, of course, had no significance for the kind of evidence on financial honesty the teacher was trying to get.
9. After getting the papers out of the way and ready to return the teacher turns to the coin boxes that had been put in the basket and carefully counts the coins that remain in each box. If the value of the coins placed in each box had been, for example, Rs. 1.35, anything less than that amount remaining in the box would indicate that the boys had not been honest.
10. The degree of honesty or dishonesty was quantified by recording the amount of money that had been removed from the box.

This method of measuring financial honesty by creating a situation where the product of honesty or dishonesty (the coins remaining in the box) might be examined, is subject to a number of limitations. One, of course, is that the whole procedure is useless unless the teacher is able to deceive the pupils regarding his intentions. Some people would object on ethical grounds. They would contend that a teacher should never intentionally deceive his pupils.

Another difficulty is, of course, that with a class of 45 pupils a teacher must have a rather large number of rupees available in small change. If some of this money disappears it might be very difficult to get back.

A third difficulty is that while this procedure might provide a good measure of honesty *under the circumstances*, it is hard to know how much relationship there would be between the pupils' behaviour in this specific situation and his honesty in connection with money in general. The "coin in the box" test in other words, does not bear much relation to the several items given on page 77 to define what the teacher meant by "financial honesty."

Getting Evidence Through Self Reports

While it is possible to get evidence on financial honesty by having a pupil describe his own behaviour in situations where money is involved the data when procured in this fashion would probably be lacking in validity. They would measure a mixture of the pupil's actual behaviour and the way he thinks he *should* behave. It would be possible to develop instruments that would reduce, somewhat, the influence upon the pupil's report of knowing what the socially desirable behaviour is but he still would find it very hard to describe himself as behaving dishonestly.

Keeping in mind the definition of honesty that appears on page 77 the simplest method of getting evidence about it through self-report would be to ask the pupil to respond to a series of items like this one:

If while walking to school you find a coin in the road and see nobody around what would you do?

- () a. I would pick it up and keep it.
- () b. I would tell the teacher that I found a coin coming to school and request him to ask if another pupil had lost it.
- (.) c. I would pick the coin up and then ask some of my friends if any one of them had lost it. If any one had I would return it to him.
- () d. I would hide the coin where I could find it on the way home and pick it up and take it there after school.

Another less direct way of getting self-reports would be to ask child to indicate how he thinks his best friend would do if he were to respond to a number of items like the ones above. In a large class the responses pupils would make to describe what *their best friends* might do would probably represent a more accurate description of what the pupils themselves would do than would their self-report. If a teacher's experiment, designed to bring about changes in respect to the financial honesty of an entire class, were to involve getting

evidence by asking for these *indirect* self-reports by having pupils describe what their best friends might do,—it would represent creative way of getting evidence.

Evidence of Honesty Based on Judgments of Others

Asking people who know other people well to render judgments of their honesty would probably be the most common method of measuring this kind of "value" saturated behaviour. Several methods might be employed. Most of them would request the judge to report a relative description. By this is meant that he would be expected to judge the financial honesty of another person in relation to what might be the honesty of some group. For example, a rating scale might be employed that would be somewhat more complicated than the one on page 81.

Honesty Rating Scale

We have like to have you help us in a research study by rating the financial honesty of the pupils whose names appear alphabetically in the columns below. For the purposes of our research we are defining a financially honest pupil as one who would *always* :

1. Try to locate the owner when he finds lost money.
2. Return the excess money if given too much change after making a purchase.
3. Call carelessly exposed money to its owner's attention so he can make it more secure.
4. Refuse to accept more than a reasonable gain in selling an article he owns.
5. Voluntarily return to the lender's father money he has borrowed if the lender disappears.
6. Be completely trustworthy when responsible for the money of others.

Using this definition please put a number in the bracket before a pupil's name according to this schedule :

5. *Extremely honest.* Would always or almost always do the honest thing as described in the definition above.
4. *Quite generally honest.* More so than most pupils of his age and background. Would usually do the honest thing.
3. *About average in honesty.*
2. *Rather dishonest.* Should be carefully watched whenever money is involved.

1. *Very dishonest.* Cannot be trusted at all in financial dealings. Will take unfair advantage whenever he sees a chance.

() 1. _____	() _____
() 2. _____	() _____
() 3. _____	() _____
() 4. _____	() _____

etc., etc.

There is another interesting and useful method for getting judgments from other people about the financial honesty of pupils. This method would involve a pupil-to-pupil comparison so that each pupil would be compared with every other pupil in respect to his financial honesty. The judge would indicate which of each pair in his judgment was most honest. If there were 45 pupils in the class, pupil "A" could then get a maximum score of 44. It would mean that he would be judged to be more honest than everyone of the other pupils. The minimum score would be a score of zero. A pupil getting this score would be judged to be less honest than everyone else in the class.

The simple proforma given below would make it possible for someone to render these judgments. The proforma involves only 10 pupils but the principle could be applied to any number.

Proforma for Pupil with Pupil Comparisons on Financial Honesty

If a financially honest pupil is defined as one who would :

1. Try to locate the owner when he finds lost money.
2. Return excess money when given too much change after making a purchase.
3. Notify the owner of money if it is exposed and liable to be stolen.
4. Refuse to take excessive profit when selling an article he owns.
5. Voluntarily return borrowed money to the lender's father if the lender disappears.

Please use the following proforma to compare each student in the left hand column with every pupil in the top row so far as financial honesty is concerned. Put a tick mark in the square whenever in your judgment the pupil named in the left hand column is more honest than the pupil in the top row with whom he is being compared.

Pupils Names							
	1	2	3	4	5	etc.	etc.
1							
2							
3							
4							
5							

etc. etc.

Whatever method of getting evidence on behaviour is used it should be one which, within the limits of time available to the experimenter, enables him to get evidence that has certain characteristics. First, it should be course, be evidence that is reliable and valid (See Chapter VII). It should also be evidence that can be quantified rather easily. We have already discussed the reasons for needing quantified or "countable evidence" when teachers experiment (See Chapter VII). Another characteristic of this evidence is that it should represent an adequate sampling of the person's behaviour in respect to whatever characteristic is being measured. In other words the specific behaviour measured should correspond closely to a person's behaviour in other similar situations.

Conclusions

Getting evidence about the kind of behaviour we have been dealing with in this chapter is certainly not easy. If the evidence is to be quantitative, valid, reliable and representative, the teacher conducting the experiment must exercise a great deal of ingenuity. In this chapter we have tried to illustrate how behaviour might be measured when it is such as to sorely tempt a pupil to keep the truth from being known. We might have chosen as an illustration various procedures to measure the kind of behaviour that is involved in a craft like carpentry. Here the validity problems would be less troublesome. It might be valuable for the reader to consider how he would go about getting evidence on the skill with which an 8th class boy was able to use of a saw, rule, and a plane to produce a smooth 6 inch square starting with irregular rough wood. It would be interesting to think about how this might be done by observation, by getting self-report, by observing the product of the behaviour, or by getting ratings from others.

We would like to stress the importance of having the teacher who is experimenting to change the behaviour of his pupils spend considerable time defining the kind of behaviour he is trying to effect. This we tried to do in connection with honesty involving money. The reader probably noted at once that the definition itself gave many helpful leads to measuring honesty or getting evidence about its existence.

CHAPTER XI

HOW TO SUMMARIZE AND INTERPRET EVIDENCE¹²

In the chapter on the importance of evidence we called attention to the necessity, in a research study, of getting facts in a form that could be counted. This kind of "countable" evidence is almost essential for any experimentation that teachers might undertake to improve their own teaching. Even when the evidence describes something as complex as a character trait, and the method of measurement is human judgments or ratings, converting the evidence into numerical units of some sort is helpful if good and objective inferences are to be made. For example, when categories like A, B, C, D and E are used for estimating the 'amount' of neatness of various pupils, these categories are usually given numerical equivalents when the estimates are used in research. The rating of A, would be given a quantitative value of 5, B would represent 4, and so on.

The main reason for wanting evidence in countable form in classroom research studies is that more exact inferences can be made regarding relative magnitudes. A classroom teacher experiments so that he can teach his pupils *more* than he was teaching them. "More" means a greater quantity. To find out if his experiment is or is not successful the teacher must determine how much he was teaching before and after the experiment. He must get quantitative evidence.

The teacher-investigator also wants usually to draw conclusions about a number of cases (pupils) or a number of measures (scores) of the same pupils. In other words he wants to know whether or not his teaching has improved not only single pupils, but a whole class of pupils. A conclusion like this usually requires some condensation of the evidence. Too many separate scores just cannot be kept in mind. Mere collections of data, however complete, varied, and useful they may be for other purposes, have little significance and meaning for most types of educational research unless they are presented in a form that makes quantitative inferences possible. Such inferences can be best made if the data are presented and arranged in a well-ordered and systematic manner.

This chapter describes how quantitative evidence about a class might be condensed and summarized so that better inferences can be made about the total group. In this connection, four questions are frequently asked about a collection of measures representing, for

¹²The authors are indebted to Dr. Helen Walker, Professor Emeritus of Teachers' College, Columbia University and to Mr. H. K. L. Chugh, Statistician, National Institute of Basic Education, for making a number of suggestions for the improvement of this Chapter. The authors, however, accept sole responsibility for the chapters' content.

example, scores made on a test by a class of children. These questions are :

1. How do the scores look if condensed and summarized in a frequency table ?
2. What is the typical or representative or "central tendency" score for the group as a whole ?
3. How much do the individual scores differ, one from the other ?
4. Do the scores bear some relation to scores from other tests or to some other measures of the same pupils ?

A section of this chapter is devoted to each of these four questions. The chapter concludes with a number of illustrations of evidence that was misinterpreted. The reader is asked to explain why.

In order to explain and illustrate how evidence or data can be condensed, summarized and interpreted we use, as an actual example, the test scores that might have been obtained by a class of 45 pupils of the sixth standard on an arithmetic test. The teacher's hypothetical problem resulted from his impression that a great deal of arithmetic was forgotten over the summer vacation. He wanted to do something to reduce the forgetting if he could. To define his problem better, and discover its scope, he gave a carefully prepared arithmetic test of 200 questions to his pupils on the last day of school in May. He gave exactly the same test on the first day of school in July, two months later, when the boys were starting the 7th standard. The results are given below :

Arithmetic Test Scores of 45 Sixth Standard Boys Before and After Summer Vacation

Boys No.	Score		Boys No.	Score	
	Before vacation	After vacation		Before vacation	After vacation
1	109	100	15	117	97
2	108	102	16	91	83
3	89	79	17	85	76
4	100	112	18	100	61
5	132	124	19	139	143
6	181	110	20	112	84
7	74	68	21	112	67
8	139	126	22	101	87
9	88	125	23	122	91
10	84	58	24	85	95
11	73	65	25	125	112
12	119	111	26	102	83
13	79	59	27	84	71
14	86	69	28	162	132

Boys No.	Score		Boys No.	Score	
	Before vacation	after vacation		Before vacation	After vacation
29	86	89	38	111	88
30	89	54	39	92	73
31	87	63	40	92	72
32	115	128	41	111	77
33	118	81	42	111	89
34	131	109	43	110	51
35	109	71	44	141	111
36	138	132	45	117	71
37	134	95			

The Frequency Table

It is almost impossible, as the reader can see, to get from these two lists of scores other than the vaguest impression of what a summer vacation does to make boys forget arithmetic. Inspection indicates that most of the July scores were lower, but pupil number 4 did better in July. So did pupil numbers 9 and 19. What a teacher must do, if he wants to interpret all of these scores is to put them in some order so that their meaning is clearer. A good way to do this is to make a "frequency distribution" or "frequency table" for each set of scores. To do this, these steps may be followed:

1. Note the highest and lowest "before" and "after" scores and get the difference between them in each case. This information is given for the arithmetic scores:

	<i>Before</i>	<i>After</i>
highest score	181	143
lowest score	73	51
difference	108	92

2. Divide the difference between the highest and lowest score (this is called the "range") by any number that will give a quotient of about 10 or 12. In the case of both sets of arithmetic scores 9 would be a good number. It goes into 108 ("before" range) twelve times and into 92 ("after" range) ten plus times.
3. Using this divisor as a "class interval" and beginning a few scores below the lowest score make a series of class intervals in which all scores can be tallied.
4. Go through all the "before" scores and put a tally for each one in the proper class interval. Total the tallies in each interval. Do the same for the "after" scores in the

"after" class intervals. Your "Frequency Table" with tables and totals should look like this :

<i>Score before vacation</i>			<i>Score after vacation</i>		
Class interval	Tallies	Total	Class interval	Tallies	Total
179-187	/	1	143-151	/	1
170-178	0	0	134-142	0	0
161-169	/	1	125-133	||||	5
152-160	0	0	116-124	/	1
143-151	0	0	107-115	||||/	6
134-142	||||	5	98-106	//	2
125-133	//	2	89- 97	||||/	6
116-124	||||//	7	80- 88	||||/	6
107-115	|||||/||||	10	71- 79	|||||/|||	8
98-106	||||	4	62- 70	||||/	6
89- 97	||||/	5	53- 61	|||	3
80- 88	||||//	7	44- 52	/	1
71- 79	|||	3			
	Total	45		Total	45

Study these two "frequency tables". Because the scores are systematized and ordered it is possible to make better inferences from them. Putting scores in a frequency table, however, is only a first step.

Measures of Central Tendency

To answer the second question about these "before" and "after" scores, namely, "what is the typical or representative score?", the teacher faces alternative. There are two commonly used indexes to indicate this "central tendency". One is the arithmetic average, also called the mean. The average is determined by adding all of the scores and dividing this sum by the number of scores,—in this case pupils. Compute the "average" or "mean" score for "before" and "after" vacation and enter it below.

average before =

average after =

If the number of scores is quite large, and they have been put in a frequency table a very close approximation of the average can be computed quite quickly. In computing this approximation it is assumed that all of the tallies in a class interval are concentrated at the very middle of the interval. The average is found by multiplying the mid point of each interval by the number of tallies in the interval. All of these products are then added and divided by the total number of scores. For the "before" scores the approximate average is 109.5. For the "after" scores 90.2. As is evident, these approximations are very close to the exact averages.

¹The correct computations appear at the end of the chapter

If you had only the above averages, either the exact or the approximate ones, as a basis for your inference what would you conclude about the effect of the summer vacation on arithmetic knowledge?

Another way of representing the central tendency of a group of scores is by an index called the *Median*. Median means the middle score if all of them are arranged from smallest to largest. If there is an even number of scores, the median is half way between the middle two scores. Rank the "before" and "after" vacation arithmetic scores and locate the *Median* for each distribution and enter it below.

Median before =

Median after =

You will note that the difference between the two means is in this particular case slightly less than the difference between the two medians. This is because the mean and median represent somewhat different ways of measuring "central tendency".

It is rather easy to get an approximate Median from the frequency distribution of the "before" and "after" scores. To do this you assume that all of the tallies in the interval in which the median falls are evenly distributed throughout the interval. For example, for the "before" scores, the median is, of course, the 23rd score from the bottom because the 23rd score is the middle score when the total number is 45. Nineteen scores are in intervals below 107. The next higher interval has in it 10 tallies. This means one must go $\frac{4}{10}$ ths of the distance through the 107-115 interval to reach the approximate median. The interval is 9 units. Hence $\frac{4}{10}$ of 9 is 3.6. This added to 107 the lower limit of the interval in which the median falls, gives 110.6 as the approximate median. Compute the median for the "after" scores in this same way. How close are these estimated medians to the exact medians? Are they easier to compute?

It is fair to ask: "Should the arithmetic average (mean) or the median be preferred as a measure of central tendency when teachers are experimenting?" Statisticians say that the mean is to be preferred:

1. When the greatest reliability or exactness is required.
2. When the scores occur rather evenly on both sides of the central tendency.
3. When later calculations that require a mean may need to be computed.
4. When a combined central tendency measure representing a number of groups, is needed.

The median is to be preferred.

1. If there are either high or low extreme scores and it is desired to reduce their influence.

2. If later calculations that require a median may need to be made.

It is our suggestion that when teachers are beginning their research, the Median is usually quite satisfactory. It is somewhat easier to compute the Median than the average and it is not influenced so greatly by extremely high or low scores.

Measuring Variability

Measures of central tendency have their advantages and limitations. There might be several sets of scores with the same mean or median but the sets would be quite different in another respect. This raises a second question about his research evidence that a teacher will want to answer. This question has to do with the *variability* of the evidence. Do the scores or observations describe a rather homogeneous or a heterogeneous group? Are the differences in scores among the pupils in the class large or small? For example, the scores for group "A" below are much less variable than the scores for group "B" even though the median 17.5 is the same for both groups.

Number of Words Spelled Correctly on a Dictated Spelling Test

Group A		Group B	
16		11	
18		18	
17		17	
16		15	
17		13	
20		20	
21	Med. = 17.5	21	Med. = 17.5
20	Range = 5	24	Range = 13

The range, however, for Group A is 5 (16 to 21) while the range for group B is 13 (11 to 24) or more than twice as great. This difference in range suggests that the two groups are quite dissimilar even though the central tendency score, or median, is the same.

It is probably not necessary to say anything more about the importance of getting some indication or measure of the variability of a group of scores. If two teachers taught spelling to two different large classes similar to groups A and B above, it would be most misleading to say the classes were alike because their medians were the same. The fact that one class is much more variable than the other means that the teacher faces quite different problems in his teaching of spelling in the two classes.

There are a number of ways to describe the variability of scores.

1. *The range*: The range is the difference between the largest and the smaller scores. This measure of variability is greatly influenced, however, by the presence of a single extreme score, either large or small.

2. *The Standard Deviation* : This measure of variability is used with the mean. Sometimes, also, the standard deviation is needed for deriving other statistical indexes. This measure of variability involves a rather long and involved process of computation. The mean of the distribution is first determined. The difference between each score and the mean is obtained and squared. These squares are added and averaged and the square root computed of the average. The reward for using the standard deviation to teachers beginning to do research hardly justify the trouble.
3. *The average or mean deviation* : This index is computed by getting the difference between each score and the mean of all of the scores and averaging these differences.
4. *The median deviation* : This index of variability is computed by getting the difference between each score and the median of all the scores, arranging these differences from largest to smallest, and getting the median.
5. *The interquartile range* : This measure of variability is easily understood and usually quite adequate. It is actually the range that includes the middle 50 per cent of the scores. It is called the *interquartile* range because it is the distance between the two quartile points in the distribution of scores. The first quartile point is the score that exceeds in magnitude 25 per cent of the other scores. The third quartile score is the one that exceeds in magnitude 75 per cent of the other scores. We are arranging both the A and B group spelling scores reported on page 90 in order from largest to smallest and indicating below what the two quartile scores are :

	~ Group A	Group B
Third Quartile=20 (Q 3)	21 20	24 21
	20.5	20.5
	20 18	20 18
Median=17.5	17.5	17.5
	17 17	17 15
First Quartile=16.5 Q(1)	16.5	14
	16 16	13 11

For the Q_3 score of Group A, half way between 16 and 17 was used. Q_1 for B is half way between 13 and 15 or 14. (Sometimes the Median is called Q : Why?) The interquartile range for A scores is seen to be 3.5 (20 minus 16.5) and for B score 6.5 (20.5 minus 14).

Using the frequency table on page 86—87 and a method like that described for getting the median compute the approximate interquartile range for each of the two sets of arithmetic scores (one before the vacation and the other after) and enter below.

Before interquartile range =

After interquartile range =

Which set of scores is more homogeneous?

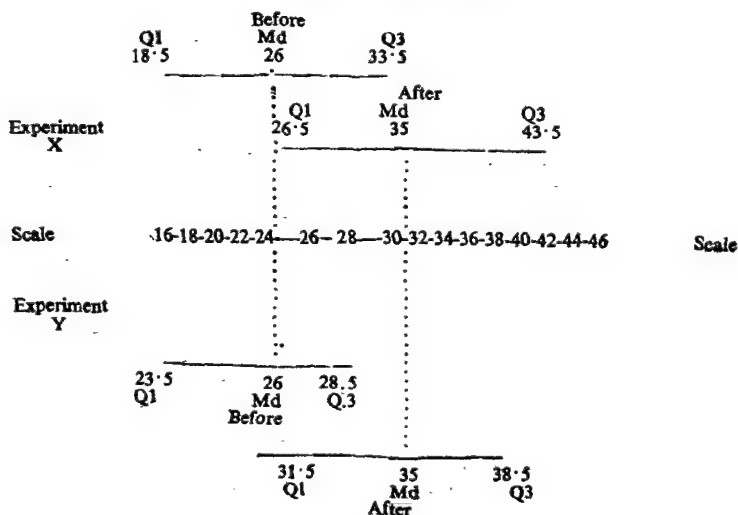
The Significance of a Difference

Another important reason for knowing the variability of two groups or scores is to help interpret the meaning of a difference between the central tendency indices for two groups of scores. How would you interpret the difference between medians in two hypothetical experiments, "X" "Y", if the medians and interquartile ranges are as given below:

				Experiment X	Experiment Y
Med. score before	..	..	..	26	26
Interquartile range before	..	..	..	15	5
Med. score after	..	..	..	35	35
Interquartile range after	..	..	..	17	7

The "before" and "after" Medians are the same. The difference between them in each case is 9 points.

A diagram of the medians and interquartile ranges of these scores might look like this:



Which of the differences between before and after scores would seem to you to have more significance? In which experiment would you say that the after scores are more apt to be "really" higher than the before scores?

In most classroom experiments a teacher measures some characteristic of his pupils before he tries a new and presumably better practice and then measures the characteristic afterward. If the difference between the results of these two measures is *large* enough, and in the predicted direction, the better effects of the new practice are said to be significant. The question is: How large is "large enough."

A rather simple way of answering this question is to use a modification of the "sign" test. To illustrate the use of this "sign" test assume that the attitude test scores given below were made by a group of 25 seventh class pupils before and after a teacher had experimented with some procedures to improve their attitudes toward mathematics.

Attitude towards Mathematics
Scale scores

(High Score = Favourable attitude)

Pupil	Before	After	"Sign" of change representing difference between "before" and "after" scores
A	20	43	+
B	23	30	+
C	43	56	+
D	40	36	-
E	30	26	-
F	40	50	+
G	36	36	0
H	40	55	+
I	46	55	+
J	30	40	+
K	46	50	+
L	46	53	+
M	36	36	0
N	36	36	0
O	50	56	+
P	33	40	+
Q	50	30	-
R	30	50	+
S	46	50	+
T	23	46	+
U	30	50	+
V	53	53	0
W	53	60	+
X	40	50	+
Y	33	30	-

Note the column headed "Sign" of change representing difference between before and after scores. If the "after" score for a particular pupil was higher (better attitude) a + is in his row in this column; if lower, a -; if the same, a 0. The first thing to do for the "sign" test is to count the numbers of plus signs and the number of minus signs. The total number of plus and of minus signs is the number of pairs showing a difference. In this illustration there were :

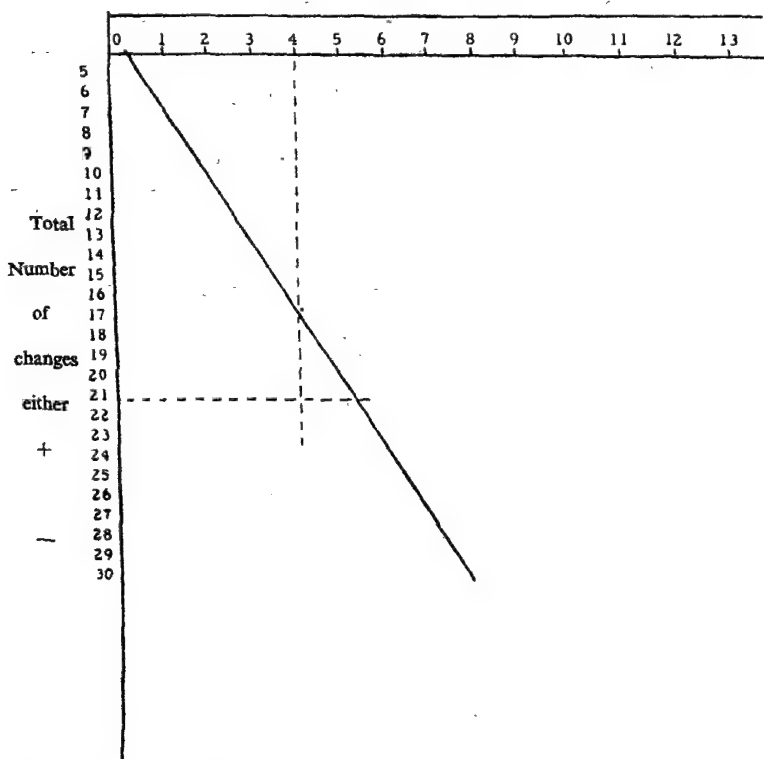
4 minus signs; "after" score lower.

17 plus signs; "after" score higher.

21 total pairs showing a difference.

If there are the same number of minus signs as plus signs or more minus signs, whatever the teacher did to change attitudes in a positive

Number of Minus Changes



direction *obviously* had little effect. If, on the other hand, the minus signs are less than half the total number of signs the significance of the difference can be determined from the table given above. In this table the left hand vertical column is used to enter the total number

of pairs where there is either a "+" or "-" signs—21 in the case of the illustration. The top row is to enter the number of minus signs, assuming their number is less than the number of plus signs. In the case of the illustration the number of minus signs is 4. If a line is dropped vertically from 4, the place where it crosses a line drawn horizontally from 21 indicates whether or not test scores in this example were sufficiently different the second time from the first time, and in the predicted higher direction, to mean that the experiment made a real difference. If the intersection falls below the diagonal line, as it does in this illustration, this is interpreted to mean that a teacher can be practically certain (95 per cent certain) that the experimental hypothesis was supported by the test data. This same table can, of course, be used in the fashion just demonstrated, to test the significance of the difference between "before" and "after" test scores in other experiments.

Measuring Relationships Among Scores

Teachers conducting experiments often want to find out what the relationship among two sets of scores is. Sometimes, too, in getting evidence to define a problem they are interested in knowing whether two traits or characteristics or measured observations are related. Some examples of questions teachers might want to answer and which have to do with the kind of relationships we are referring to are given below:

What is the relationship between the number of days a pupil is absent from school and his school marks?

What is the relationship between a pupil's reading ability as measured by a standardized test and his marks in history?

What is the relationship between degree of mastery of the fundamental processes in arithmetic and ability to solve arithmetic problems?

What is the relationship between interest in a school subject and success in studying it?

What is the relationship between a pupil's performance in crafts and his achievement in school subjects?

To illustrate further what we mean, refer back to the table of scores made by the same 45 pupils on an arithmetic test before and after the summer vacation (page 86-87). How would you answer these questions about these scores:

Did the boys who did best *before* the vacation also do best *after* the vacation?

Is a boy's standing in the group before the vacation about the same as his standing in the group after the vacation?

Is it easy or difficult to find out from an inspection of 45 scores the existence or absence of relationships like these?

Could the relationship possibly be inverse or negative? This means that a high score before vacation is associated with a low score afterward.

In research studies it is not enough to say that a relationship is close, or high, or low, or inverse, or medium. A more exact quantitative description is needed. To provide more exact descriptions of relationship, a number of indexes have been developed by statisticians. The one most commonly used in educational research is the **COEFFICIENT OF CORRELATION**. The coefficient can be computed whenever there are two sets of scores for the same pupils as is the case for the study of the effect of a summer vacation upon arithmetic scores. The magnitude of the coefficient of correlation ranges from $+1.00$ through zero to -1.00 . The approximate meaning of positive (+) coefficients of different sizes is suggested below :

- $+1.00$ This size coefficient of correlation indicates perfect *positive* relationship. In other words, if two tests were given the same group of pupils and the boy who ranked first on one test also ranked first on the other, and so on *without any exceptions*, the correlation or relationship between scores on the two tests would be perfect and indicated by an index of 1.00 . A perfect relationship like this is rarely if ever found in educational researches.
- $+.90$ A coefficient of this size indicates a very close but not perfect positive relationship between two sets of measures. When the same carefully standardized test is given twice to the same group of pupils, the second time after some interval, the correlation between the scores may be thus large.
- $+.75$ This size coefficient indicates a high positive relationship. If the boys in a Basic school were all weighed and ranked from the heaviest to the lightest and then the same boys measured for their height and ranked, the relationship between the two, weight and height, would be indicated by a correlation coefficient of about $+.75$.
- $+.50$ A coefficient of this size indicates an appreciable but not a high positive relationship. The relationship between scores a group of pupils might get on a good test of intelligence and their marks on a standardized battery of achievement tests might be about $+.50$ if measured by the coefficient of correlation.

Some relationships are negative or inverse,—the pupils doing well on one test do relatively poorly on a second test. A perfect “inverse” or “negative” correlation would be indicated by a coefficient or index of -1.00 . This would mean that the pupil who did best on one test would do worst on the second test. The pupil who ranked second from the top on one test would rank second from the bottom on the second test. The pupil who ranked third from the top on one test

would rank third from the bottom on the second test and so on **WITHOUT** any exceptions. A perfect negative correlation is as uncommon in educational research as a perfect positive correlation. Almost all educational measures are related positively.

There are many ways to compute the coefficient of correlation. Some ways are quite time consuming and involve the use of complex formulas. There is, however, a quite simple way of arriving at a good estimate of the coefficient of correlation. The estimate is close enough to the actual correlation to be adequate for most of the experiments conducted by teachers to improve their own teaching. The method involves getting the percentage of pupils who have taken the *same* test twice, or have taken a first and second test, and whose scores are on the same side of the median in each test. You have already computed the median for the "before" and "after" vacation score in arithmetic for the 45 boys whose scores appear on page 86-87. Go back and count the number of boys whose scores place them, *on both tests*, either above or below the median *each time*. Use as the median for the "before" scores 110 and for the after scores 87. Boy number 1 is below the median "before" but above "after". So is boy number 2. Boy number 3 is *below* the median before and after. He is the first tally of a score either below or above the median both "before" and "after" vacation. Boy number 4 is below "before" but above the median "after". He is not counted. Boy number 5 is above the median both times. He is counted, as are boys numbered 6, 7, and 8 but not number 9. Why?

After counting all the boys who are either below or above the median both before and after vacation, divide this total by 45 to render it in percentage form.

The table given below enables you to find out the approximate coefficient of correlation from knowing the "percentage of like signs." What "coefficient" did you get? How would you interpret a coefficient of this size?

Table for Estimating Coefficients of correlation from Percentages of Like Signs*

Percentage of like signs	Coefficient of Correlation	Percentage of like signs	Coefficient of Correlation
100	+1.00	45	— .16
95	+ .99	40	— .31
90	+ .95	35	— .45
85	+ .89	30	— .59
80	+ .81	25	— .71
75	+ .71	20	— .81
70	+ .59	15	— .95
65	+ .45	10	— .99
60	+ .31	5	— .99
55	+ .16	0	—1.00
50	.00		

*Adopted from *Danlop and Kurtz* p. 98.

Mistakes Inferences from Quantitative Evidence

Even when evidence is in quantitative form, it is easy to draw the wrong conclusions from it. To illustrate this we are giving below ten instances in which the quantitative evidence or data reported would be misinterpreted by many people. Can you tell why the conclusion was wrong in each case? After you have read each illustration carefully and tried to figure out how people were misled, turn to the end of the chapter for the explanations.

1. In the state of Bengal an estimate of the typical district size was the average of all district populations. The use of the average or mean as a measure of "central tendency" led to a serious overestimation of the size of the *typical* district. Why?
2. An official government questionnaire study of annual family income in a certain state resulted in a figure of Rs. 1500. This turned out to be well below the actual average income. What do you suspect might be the chief reasons for this error?
3. The Commissioner of Police in a large Indian city issued a report that showed an increase of 35 per cent in crime in 1955 over 1950. This was based upon police records. The percentage proved to be very misleading to many people for two reasons. What were they?
4. Two independent but highly reputable and competent teams of interviewers asked Negroes if the United States army was unfair to them. One research team received 35 per cent affirmative answers, the other only 11 per cent. Why do you think this may have happened?
5. A number of years ago a comprehensive census taken in one district in China for military and taxation purposes indicated a total population of 28,000,000. Two years later a census of the same territory for famine relief gave a population of 105,000,000. How would you explain the increase?
6. Mental and nervous diseases appear to be more common among men in India than women. On the assumption that there is no actual difference how would you explain the findings?
7. A carefully conducted study of local literacy records in India indicated that there was a higher percentage of illiterates in state "A" than in state "B". What would you want to know before concluding that the actual literacy rate was higher in state "A"?

¹ A number of these problems are adapted from Wallies, W.A. and Roberts, H.V. *Statistics: A New Approach*. Glencoe, Illinois, The Free Press, 1956, 646 page

8. During the four year duration of World War II about 175,000 people in one of the countries at war were killed in civilian accidents and about 408,000 were killed in the armed forces. How would you criticize the conclusion that it is only slightly more than twice as dangerous to be in the armed forces as it is to stay at home?
9. The death rate from tuberculosis is far higher in the state of Arizona (U.S.A.) than in any other State. What criticism would you make of the conclusion that Arizona is bad for tubercular people?
10. In the All Indian Education survey the statement was made that about 72 per cent of the total *rural habitations* (hamlets, villages, etc.), did not have schools in 1957. Some people concluded from this that 72 per cent of rural children had no schools available to them. Would you draw this same conclusion. Why?

A word or two is given below about each of the above instances to suggest some of the limitations they illustrate in thinking about data or research evidence.

1. One district is so large as to make the average or mean *as an indication of central tendency* quite misleading. What central tendency index would be better?
2. (a) Small items of incidental income overlooked.
(b) Desire to avoid taxes.
3. (a) Possible differences in police definitions of crime.—1950 and 1955, and
(b) possible increase in the city population.
4. One team Negro; one team not.
5. Obyious explanation.
6. More exposed and public life of *men* in India (women kept at home and protected) leads to more frequent detection of serious psychological disorders in men.
7. Possible differences in definitions and ways of testing for literacy in two states.
8. Total populations involved in the ratios are greatly dissimilar.
9. Arizona's climate is considered helpful for tubercular people and consequently attracts many of them.
10. Each of the smallest rural habitation of which there are a great number, has in it fewer children than each of the larger rural habitations. In this percentage, however, the smallest is given the same weight as the largest.

*Correct Computations for the "Before" and "After" Vacation
Scores on the Arithmetic Test*

	<i>Before</i>	<i>After</i>
1. Average or mean (Exact)	109.3	89.9
2. Average or mean (Using mid-points of class intervals)	109.5	90.2
3. Median (Exact)	110	87
4. Median (using frequency table)	110.6	89
5. Interquartile range	31	37
6. Approximate correlation before and after	+ .75	



8 JAN 1962

CHAPTER XII

HELPING TEACHERS TO EXPERIMENT

This final chapter, the longest in the book, has been written primarily for school administrators. The reasons for this is that the authors believe that headmasters, inspectors and other persons with special responsibility for educational leadership are in an excellent position to encourage teachers to experiment. They can also provide teachers with some of the resources needed for experimentation.

The chapter is divided into three parts. We first comment upon two different conceptions of educational leadership that have quite different implications for teacher experimentation. Next we describe some general conditions within a school that seem to make it easier for teachers to test out their own promising ideas in order to improve their teaching. Finally, we suggest a number of things the school administrator might consider doing to help the teacher at each stage of his research.

Two Points of View Towards Leadership

Whether or not a principal or headmaster is inclined to encourage teachers to experiment depends, in part, upon the way he thinks educational leadership should be provided. For many years in the past, and even now in many places, the educational leader has thought of himself as the person who, almost alone, was responsible for improving the educational programme. The leader thought of himself as one who knew more about teaching than his teachers did. He observed what they were doing, told them how to do better, and saw to it that they followed the directions. Supervision involved telling teachers what to do and checking on them to be certain they did it.

As we have said, this way of providing educational leadership is still quite common. Undoubtedly it has resulted in improvements in educational practice. It probably has resulted in more changes "on paper" than changes in the attitudes, understandings and skills of teachers. The approach to educational leadership that involves telling teachers what to do seems to make its strongest appeal to school administrators, who, by temperament, are somewhat dominating and paternalistic. The method appeals most to teachers who are inclined to be dependent, not too resourceful and disposed to want to be told what to do rather than work things out for themselves.

Within the past twenty or thirty years a different idea about educational leadership has gained many supporters. This changed conception of the best way for a school administrator to get teachers to improve grows out of the conviction that good teaching is far too dynamic and complex to make it possible for someone to prescribe

each detail of the teacher's activity. For work involving the performance of some routine task, supervision that consists of giving directions for dealing with every situation and keeping a close watch to see that the directions are followed may be effective. The good teacher, though, needs more freedom. He must adapt what he does to the unpredictable and complicated classroom situation. He must be encouraged to use his own initiative and resourcefulness. He must be encouraged to try out promising innovations experimentally.

The newer conception of leadership does not define a leader as one who diagnoses teaching situations and tells teachers what to do. He, on the other hand, is viewed as one whose major job is to inspire teachers to want to do better, and to provide the resources they need as they creatively try out new and more promising practices. This kind of educational leader, whether he is a principal, a headmaster, an inspector, or a member of some state department of public instruction, has as his major responsibility to encourage teachers to talk freely about the problems they are facing, and to listen to them sympathetically. He helps them think through the possible solutions to these problems and tries to make available whatever resources he can for trying out innovations, carefully and systematically. In a word he is a *helper* and *guide* and *stimulator*, rather than a 'boss'.

The newer conception of leadership makes its strongest appeal to headmasters, inspectors and others in administrative positions who have two distinguishing traits. First, they have accepted more than the political implications of democracy. They believe that individuality is to be valued and instead of requiring subordinate teachers to follow orders from above they should be encouraged to work as free and creative participants in the cause of children's education. Secondly, school administrators accepting the new conception of leadership have sufficient self-confidence and self-respect so that they do not need the feeling of power that comes from forcing teachers to obey or follow instructions slavishly.

Teachers respond best to the leader who is a stimulator, guide and helper if they have more than average faith in their own ability to deal with instructional problems, and would prefer to have help doing this rather than to be told exactly what to do by an administrative superior.

This chapter is written in the hope that at least a considerable number of the school administrators who read this book have some sympathy for the point of view that a school administrator can be effective if he tries to be a helper, and guide and stimulator, and provides resources rather than gives directions or orders.

School Conditions that make Experimenting Easier

In our work with teachers who are trying to become better teachers by doing research we have found that the general atmosphere of the

school is important. In some schools there is no experimentation and it never seems to get started. In other schools a number of teachers experiment. What is the reason for this? In the next few paragraphs we describe some of the general conditions that seem to make experimentation easier.

Encouragement to be self-critical: School experimentation is not apt to be undertaken unless teachers feel free to talk not only about their successes but about their failures as well. This kind of self examination and self criticism will not take place if teachers are afraid. Nor is it apt to take place if they believe that any admission that they may be less than perfect will be held against them by their administrative superiors.

One thing the administrator can do to encourage teachers to take a constructively critical attitude towards their own work is for him to set a good example in this regard. We mean by this that he must be willing to examine his own professional activity critically. Teachers are not apt to speak openly about classroom situations with which they are unable to cope in the presence of a headmaster or inspector who gives the impression that he thinks he is perfect.

The teachers, of course, know that headmasters or principals or inspectors are not perfect, because no one can be. Some school administrators, however, in their visits to classrooms, seem impelled to note and comment on everything they see that they think is wrong. Nothing is said about what the teacher has done well. If the teacher's room is mostly neat and clean but there is ink on the wall it is only the ink spot that is noticed and commented on. If the teacher asks his pupils twenty good questions and one that is not clear, it is this one that is singled out and used to make the teacher feel inferior. Emphasizing the negative rather than the positive seems to make some school administrators feel very important, perceptive and wise. They appear to want to create the impression that they "know it all." They rarely recognize and admit in their remarks to teachers that some of the things that are wrong are very hard to put right. Their approach implies that every difficulty has a quick solution and teachers are to be criticized for not knowing it.

When the school administrator seems to the teachers to be critical of anything less than perfection, and when he makes no admission of any of his own baffling professional problems, teachers can hardly be expected to admit their limitations.

Freedom to experiment: For a teacher to decide to conduct an experiment intended to improve his own teaching requires courage. No one can be assured that an experiment will succeed. The word "experiment" means that the outcome cannot definitely be predicted. The evidence a teacher gets may indicate that his hypothesis was not a good one. What he thought to be promising idea turns out to be

a poor one. While it is true that this happens less often if the problems diagnosis and search of solutions and design of the experiment and procurement of evidence are of a very high quality, still an experiment is always an experiment. If someone knew in advance just how it would turn out, there would be no need to experiment.

What this means is that the headmaster or inspector who wants to encourage classroom teachers to experiment must not give the impression that every innovation they try has to turn out to be a blazing success. If teachers have this impression but still go ahead and experiment, they are under great pressure to make it look as if the experiment were more successful than it was.

Freedom to experiment means freedom to fail. Freedom to fail, however, does not mean that the teachers should be "free" to be careless or dogmatic or haphazard as they experiment. Only those new ideas should be tried out that give great promise of being an improvement over what has been done before. And the try out should be so planned and designed as to determine the actual worth and promise of the new idea.

Providing for staff cooperation : It is best if a number of teachers on a school staff, or even all members of the staff, can experiment together cooperatively. If they keep in touch with one another and help one another throughout the experimentation, there are many advantages. For one, the risk each teacher takes when he experiments is less threatening if he realizes that other teachers in the same school are also willing to take some chances in order to improve. As we have said nobody can experiment, nobody can be creative as he tries out new practices that *seem* more promising, without taking chances.

When each member of a group of teachers in the same school is experimenting it is easier, too, for anyone to admit and frankly discuss whatever it is about his teaching that dissatisfies him. This is true, of course, only if the members of the staff respect one another and have developed ways of communicating easily and in a friendly way with one another. We have more to say about this below.

There is a final and even more important reason for cooperation among staff members in their experimentation. This reason is that there is more wisdom represented in a group of teachers than any one teacher has himself. A teacher, for example, who wants to experiment to improve his teaching of arithmetic can get help from his teacher-colleagues at every step in the process. They can help him define his problem with more precision. They can help him in his search for more promising practices to try. They can help him get better evidence. Because their experiences have been different from his, he will be enlightened while discussing the problem and listening to the experiences of his colleagues. Furthermore, he can test out his ideas on his fellow teachers and thus improve them.

What can the school administrator, the headmaster or principal do that will encourage this cooperative staff discussion of the problems each teacher is trying to solve through research? He can, if he wishes to, become something of an expert in making staff meetings good ones. He can himself set an example of the good group member at staff meetings where teaching problems are up for consideration. His example may go far to help his teachers become better members of a staff group. To do this is not easy but it is worth the effort to try.

A long step is taken in the direction of improving the staff discussions of teaching problems when a headmaster or principal considers *with his teachers* what can be done to make the staff meetings more inspirational and helpful,—what can be done to improve the quality of the group discussion. It takes a bit of courage, often, to raise these questions in staff meetings, especially if the administrator fears that doing so would be interpreted as meaning that he needs help.

A headmaster or principal who is interested in working with his teachers to improve staff meetings might start doing so in a straightforward way. He could distribute a proforma after a staff meeting asking his teachers a few questions. A small committee of teachers could summarize the replies and report to the next staff meeting. This proforma might be used :

Staff Meeting Reactions

1. Please put a tick mark on the scale below to indicate how you felt about today's staff meeting.

very poor	below average	about average	above average	excellent meeting

2. What was best about today's meeting?
3. What was least satisfactory about today's meeting?
4. How can we improve our staff meeting?

Provision of Time and Material Facilities: In the preceding chapters there have been many illustrations of teachers needing some additional facilities, such as cyclostyling, if they are to experiment successfully. The school administrator, of course, is in the best position to provide these facilities. Just what they may turn out to be, cannot be described here. Their nature depends upon the type of experimentation under way in the school. Often the wise headmaster or principal can help a teacher devise less expensive ways of trying out his new idea. We have suggested some inexpensive ways of getting evidence in Chapter VII.

Time is often needed by the teacher interested in experimentation—time to plan, to gather data, to read relevant literature, to create better instructional materials, to discuss various points of view, and to prepare reports. This time can sometimes be made available if the

headmaster or principal can relieve the teacher from some of the routine administrative tasks that every teacher is asked to accept responsibility for such as collecting fees or maintaining registers. A feeling of freedom to experiment, combined with patience and an insightful understanding of the various stages and advantages of experimentation go a long way in encouraging classroom teachers to take up even time-consuming responsibilities. The present authors have often noticed that when members of a staff feel strongly involved in a job, and are aware of the sympathetic and encouraging leadership of a 'head', they work with a tremendous sense of responsibility, apparently unmindful of toil and time.

Helping in Each Aspect of the Research Process

What we try to do in this section of our final chapter is to describe again, in a very abbreviated form, the several aspects of the process of experimentation that were considered in detail in chapters IV and V. We then suggest a number of things that school administrators might do that would assist the experimenting teacher at each stage of his research. This part of the chapter reflects our conviction that a competent and conscientious school administrator, interested in encouraging his teachers to experiment, can, if he wishes, learn to do many things that will help them. He can assist them to become more critical of their own teaching, and to define more carefully their specific teaching difficulties. He can try to provide teachers with a greater variety of experiences from which they may find a more promising solution to their instructional difficulties. He can help them formulate and test hypothesis with greater precision. Finally, there is much the school administrator can do to enable teachers to get better evidence regarding the success or failure of their experiments.

In brief, we are urging the school administrator to consider himself, so far as teacher experimentation is concerned, as a research consultant. This may be a novel, but we believe it would be an interesting role for many headmasters and principals. It would bring them in line with the vast area of life in a modern culture where scientific methods are used to solve practical problems.

Helping teachers become constructively dissatisfied with their own teaching: As we tried to make clear in Chapter V, it is no more than common sense to expect a teacher to experiment only if he is somewhat displeased with what he is doing. Attempting to improve would seem always to involve at least a degree of self dissatisfaction. What can the school administrator do that will increase the likelihood that teachers will become dissatisfied with certain aspects of their own teaching? We are suggesting below several things he can do:

1. Talk with teachers in a sympathetic, friendly way, asking if there is anything he, the headmaster or principal can do to be helpful. This talk should not result in praising or

blaming the teacher. It should be to enable the teacher to realize and face the fact that improvement is always a possibility and it best starts with self dissatisfaction.

2. Occasionally talk with teachers about the puzzling professional problems headmasters or principals face. Seek their help and ask their advice. This is no more than honest. For the headmaster to admit that he too has problems that puzzle him makes it easier for teachers to discuss theirs. If the headmaster fears that doing so will lose the respect of his teachers the respect is resting on a shaky foundation.
3. Encourage teachers to get evidence to support their beliefs about what they are doing. The following conversation may illustrate how this might be done :

Teacher : My pupils learn to like good literature in my English class.

H. M. : Very good. That should happen in an English class. What do the pupils do that indicates that their taste in literature has improved ?

Teacher : I can tell by what they say in class. They have learned that William Shakespeare is a great playwright. They speak with admiration of his plays.

H. M. : Fine. It might be interesting, too, to find out what they choose to read outside school. This might also indicate their reading taste. What do you think ?

Teacher : Yes. But how could I find out ?

The headmaster then might suggest one or two ways for the teacher to get evidence on the pupils' leisure time reading choices. This evidence might lead the teacher to be less satisfied with his teaching of literary appreciation.

4. Arrange for teachers to visit excellent teachers in other schools. What is done elsewhere might make the teacher see some of his own limitations.
5. Arrange for a small conference of all teachers who teach the same subject in his school to discuss their problems.

These few suggestions as to what a headmaster or principal might do to help teachers see the limitations in their own teaching do not by any means exhaust the possibilities. Each suggestion, though, is intended to show how the school administrator might help the teacher to discover *for himself* what his possible deficiencies are. Had the headmaster told the teacher what the headmaster thought was wrong with him, the teacher's first impulse would naturally have been to defend himself.

Helping the teacher to develop hope that his problem can be solved: Dissatisfaction unaccompanied by hope leads to discouragement. Dissatisfaction with hope leads to attempts to do better. The administrator can do a number of things to help the teacher realize that he can do something about the limitations he has become aware of in his own teaching.

1. In his talks with teachers the school administrator can purposely take a positive, optimistic approach. It is almost always true that no matter what the limitations are, something, at least can be done to reduce them. Teachers are never too old to learn new skills if they want to.
2. In helping the teacher narrow down and focus his dissatisfaction (*see* p. 31) the headmaster or principal is taking a positive step to develop hope. A big problem can usually be broken down into a number of little problems that can be tackled one at a time. This will seem feasible. The big problem may have been discouraging.
3. Knowing about inservice education would enable the school administrator to discuss with the teacher the various resources that are available to help him in his efforts to do better. If there is an Extension Services Department nearby the teacher might learn that he could be deputed to a training course or workshop.
4. The headmaster, by showing genuine interest in a teacher's desire to improve himself, and standing ready to provide what aid he can, would help a teacher be more hopeful about improving.

Defining and focussing the Classroom Problem: Many instructional problems that a teacher might recognize and desire to do something about are so comprehensive as to make constructive attempts to solve them almost impossible. As we have said in chapter V, what must be done is to narrow the broad problem down, to focus it, and to define or describe it very exactly. This often makes it possible to attempt to deal with the situation. A teacher who is distressed because all of his classes are so large, is probably discouraged at the very thought of trying to do anything constructive about this comprehensive difficulty. If he is helped to understand that he might see what methods he can experiment with in one class, however, and if his experimentation is limited to a single aspect of his work with that class, say class discussion, he is much more apt to step forward on the road to improvement.

What can the headmaster or the school administrator do to help a teacher define his problem and narrow it down so that it can be tackled? We have this suggestion:

In his talks with the teacher the headmaster or principal can help him define or speak more exactly about the classroom problem that bothers him. This is only possible if the headmaster or principal is a skilful counsellor like the principal speaking in the following conversation :

Teacher : My classes are just too big. Sixty-five pupils in one group are far too many.

Principal: Sixty-five is a large number. When you say "too big",—you mean too big for what? Is your room too small?

Teacher : No, it is n't that. Too big to teach well is what I mean.

Principal: Oh, I see. Is it much harder to lecture to 65 pupils than to 40? What is it that the added 25 pupils do that creates the problem?

Teacher : No, when I lecture the larger group makes little difference. It's when I,—(pause) when I have a class discussion that I'm baffled. I don't seem to be able to have a good discussion with 65 pupils.

Principal: Oh, I see. This would seem to be a problem. Let's talk about just one of your classes, History. How much class time do you spend in discussion each week?

Teacher : Not very much, now, probably only 30 or 40 minutes. But I'd like to have more discussion, but it doesn't work.

Principal : Hm-m-m. May be we can do something. When you say the discussion "doesn't work", what goes wrong?

Teacher : Nothing goes wrong, exactly, but most of the pupils just don't take part in the discussion. They just sit back.

This principal, by asking good questions, and listening carefully, helped the teacher narrow down his problem—from "My classes are just too big" to "most of the pupils in my History class do not participate in class discussion." This is a situation with enough focus and definition to start to work on. The reader noted, we are sure, that the principal himself did not narrow the problem down. He asked questions and made observations that enabled the teacher to focus his dissatisfaction.

Helping the teacher diagnose the difficulty : One of the most important aspects of classroom experimentation is the diagnosis a

teacher makes of an instructional difficulty in order to find out, to the best of his ability, what causes it, what brings it about. A teacher who undertakes a careful diagnosis searches for reasons for the problem's existence. Anything that is done to remedy the troublesome situation is done as a result of what this search reveals. As we said in chapter V, it is as important for the teacher to diagnose a difficulty before trying to do something about it, as it is for a doctor to diagnose a sickness before prescribing medicine.

What can the headmaster or the inspector do to assist the teacher to make a better diagnosis? We have found that most help can be given to teachers in this area through talking with them. The talk is focussed upon helping the teacher work out better answers to these questions :

1. What are known to be causes ?
2. What are suspected to be causes ?
3. How can evidence be obtained to test these suspected causes to find out whether or not they are actual ?
4. Which of the known causes can be eliminated or have its influence reduced *by the teacher* ?
5. Of the causes the teacher can do something about, which ones are most important ?

We wish to stress again that the headmaster or principal talks with the teacher in such a way as to help the teacher discover, for himself, whenever possible, the best answers to these questions. His purpose is not to tell the teacher what he believes are the best answers. Compare these two conversations :

Conversation I

Teacher: My pupils do not do their homework.

Headmaster: Why don't they?

Teacher: I just don't know what the reason is.

Headmaster: Probably you don't punish the pupils who do not do their homework. Am I right?

Teacher: Well,—I may not always punish them.

Headmaster: That must be the reason—they need punishment when they don't do what they should.

Conversation II

Teacher: My pupils do not do their homework.

Headmaster: This is a problem many teachers face. I wonder why pupils do not do their homework. What is your opinion?

Teacher: I just don't know what the reason is.

Headmaster: It might be worth-while to try to find out. Do you think so?

Teacher: Yes, I guess so. I've always thought it was just plain indiscipline.

Headmaster: That names it but hardly explains it. Is it usually that only some pupils give you this trouble about homework?

Teacher: Is it because I don't punish them when they don't that they fail to do their homework?

Headmaster: That's the way it looks to me.

Teacher: Usually, Yes.

Headmaster: Might you be in a better position to do something about the situation if you could find out, from those pupils, why they don't do their homework?

Teacher: Yes, that seems reasonable.

Which conversation do you believe would result in the teacher thinking more critically about the probable causes for pupils not doing homework? Which conversation would you think more appropriate for helping the teacher solve the problem? What is the role played by the Headmaster in each of these conversations? Which role would you prefer? Why? Underline some of the words which emphasize the role of the headmaster as helping the teacher to diagnose the difficulty.

Helping the teacher search for promising solutions : Having completed his diagnosis of his teaching difficulty, and having identified the causes he wants to do something about, the teacher searches for some action he can take that will either eliminate them or reduce their influence. This search is most apt to be successful if the teacher has access to a great number of resources. What can the headmaster or inspector do to assist the teacher in searching for more promising practices or materials?

1. He can help the teacher locate and read articles and books that may describe actions or solutions that someone else has tried and found useful in similar situation. Often an Extension Service Department, or a nearby College or University, makes available books and journals on educational subjects with which the headmaster or principal might be in general touch.
2. He might arrange for or ask others to arrange for seminars or workshops which experimenting teachers might attend at which experts might help them identify possible solutions for their problems.
3. Working with the inspector he might arrange for meetings of teachers from neighboring schools. All of the teachers convened would be concerned with problems in the same general areas. They would exchange their experiences and describe ways and means they had used to deal with common problems.
4. Visits to other schools might be arranged for an experimenting teacher. Schools would be chosen, with the help of inspectors, in which teachers had been noticeably successful dealing with the experimenting teacher's instructional

problem. Seeing and hearing about all of this might suggest some things that he might try.

5. The headmaster might arrange special staff meetings for discussing such problems and encourage cooperation among teachers.
6. A Supervisor or an Education Officer may find out talented, resourceful and experienced teachers and make it possible for them to go to different schools during a particular period in order to help the teachers start experimenting with more promising procedures.
7. Reports of seminars, workshops or other guidance and help programmes could be cyclostyled or printed for distribution among schools. A periodic bulletin at a district level may be brought out giving accounts of experiments conducted by other teachers. An experimentation question-box might be organised so that teachers could ask questions and get replies from competent persons.

The suggestions mentioned above are only indicative of the various ways in which administrator could help teachers in their search for promising solutions.

Helping teachers hypothesize : In due course a teacher decides upon one or more things he wants to try. He predicts that they might reduce the seriousness of or even eliminate his teaching difficulty. Using research words, he "formulates a hypothesis" that he wants to test in an experiment. What can a principal do to assist a teacher in formulating a hypothesis that is feasible, and testable and exact? We suggest that the most helpful thing to do is to assist the teacher in formulating a hypothesis that clearly has a close relationship to his *diagnosis of causes* and his *search for promising practices*. Assume, for example, that a teacher wants to take some action to improve his pupils' ability to make good estimates of answers to arithmetic problems. His diagnosis indicates that one important reason for poor estimates is lack of experience in making them. His search for a solution worth trying causes him to decide to experiment with having pupils :

- (a) Make quick estimates of the correct answer to arithmetic problems read out to them.
- (b) the problems will be arranged in approximate sequence from easy to difficult.
- (c) the pupils will hear immediately the correct answers and
- (d) the pupils will explain their method of making their estimates as soon as they hear what the correct answer is.

This promising action then might be formulated by the teacher, with the help of the principal, into the following action research hypothesis :

If I spend one class period a week :

- (a) having pupils make quick estimates of the answers to arithmetic problems arranged in a list from easy to difficult, and
- (b) inform them of the correct answer as soon as the estimate is spoken, and
- (c) ask them to explain how they made their estimate as soon as they hear the correct answer.

then their ability to make correct estimates of the correct answers to problems they have not seen before will improve.

This hypothesis is feasible, testable, and stated in sufficient detail to make possible the planning of an experiment.

Helping teachers plan their experiment : Probably the most important thing about a teacher's design for his experiment is the way he intends to get "before" and "after" evidence regarding the extent of his problem. It is the comparison of these "before" and "after" data that tells him whether or not what he tried to do to improve was really successful and to what degree.

It requires quite a special knack for principals or headmasters to be helpful on this aspect of getting evidence for research. The school administrator himself must be one who values evidence and knows where to look for it. In his work with teachers who are experimenting he constantly asks questions like these :

How do you know ?

What do the pupils actually do that makes you think this about them ?

How can you get evidence on that ?

Do you feel that that kind of evidence is quite convincing ?

What criticisms would you make of that kind of evidence ?

How might we get better evidence on that ?

How might we quantify that evidence so that we could count it ?

The headmaster or principal would remember that no evidence is perfect. He would also remember that a little evidence is better than no evidence, and that, as we quoted Dr. Thorndike as saying in chapter VII, "Everything that exists, exists in amount; and everything

that exists in amount can be measured," and we might add, "can be measured better."

Conclusions

In this chapter we have suggested many things the school administrator, especially the principal or headmaster might do to encourage, support, and assist teachers who want to do research, to experiment, to improve themselves. We have hoped that he might give serious consideration to rethinking his conception of providing teachers with leadership if hitherto he has been disposed to give teachers many orders as a way of making them better. We have mentioned some things he might do to try to develop an atmosphere in his school that would make experimentation by teachers easier. Finally, we suggested that he should try to act as a research consultant to his teachers, providing advice and counsel at each step in the research process.

We have waited until this final paragraph to describe the best way for the school administrator to learn how to help teachers do research. It is for *him* to experiment to improve *his own* professional practices. Doing so will acquaint him with the problems and rewards of research as a way of trying to cope with practical problems. His wisdom about such matters will then be based upon direct experience rather than reading.

BIBLIOGRAPHY

Our assumption in writing this book has been that it would be used mostly by classroom teachers who do not have readily available reference books on educational research. This is the reason we have infrequently used footnote references to the professional literature. Had we been writing for educationists we would have made a strenuous effort to call attention to additional readings on most of the topics we have dealt with.

Since completing our manuscript it has been suggested to us that what we have written might be useful in connection with some of the papers offered for the B. T., B. Ed. or M. Ed. degrees. Consequently we are annotating briefly below a few references having to do with research by teachers and related ideas :

A. ACTION RESEARCH

The first five of the following publications are similar in that each is a report of the proceedings of an action research workshop lasting at least one week. The workshops were held at various training colleges in India and were for the purpose of building interest in classroom experimentation as well as teaching some of the relevant concepts and skills. The action research workshop reports are listed in order of their publication.

1. Action Research Workshops—A Report. Extension Services Department, Sri Ramakrishna Mission Vidyalaya, Teachers College, Coimbatore District, 1957.

2. Action Research in Education—Report of the workshop, Secondary Teachers College, Belgaum, 1958.

3. Action Research Workshop (Second Report) Extension Services Department, Sri Ramakrishna Mission Vidyalaya, Teachers College, Coimbatore District. 1960.

4. Workshop on Action Research. Extension Services Department, Dev Samaj College for Women, Ferozepore city, 1960 (includes a bibliography on action research and related topics of more than 100 titles).

5. Workshop on Action Research. Department of Extension Services, Teachers College, Mysore, 1961.

6. Corey, Stephen M. Action Research to Improve School Practices. Bureau of Publications, Teachers College, Columbia University, New York, 1953.

A short book which develops and illustrates the thesis that teachers, supervisors and school administrators might make better decisions and engage in better practices if they were to conduct research as a basis for dealing with classroom problems.

B. EDUCATIONAL RESEARCH

1. Good, Carter V. and Scates, Douglas E. *Methods of Research*. Appleton-Century-Crafts. Inc. New York, 1954.

A comprehensive (900 page) treatment of research methods with innumerable references to the published educational investigations, mostly American. One of the best known standard works on educational research.

2. Harris, Chester W. (editor) *Encyclopedia of Educational Research* (Third edition) The Macmillan Co., New York, 1960.

A critical 1500 page summary of the findings of educational research. The volume is mostly American and is well indexed and includes carefully selected bibliographies. Some 200 experts prepared the summaries. A rich source of what is presently known about a host of educational problems.

3. Rusk, Robert R. *An outline of experimental education*. Macmillan and Co. Ltd. London, 1960.

A short book describing the techniques of experimentation in the various fields of education. Considerable emphasis is given to the practicability of educational research.

C. STATISTICS AND MEASUREMENT

1. Garrett, Henry E. *Statistics in Psychology and Education* (Fifth edition). Longmans, Green and Co., London, 1958.

One of the best known and most widely used elementary texts in statistics. It develops and illustrates all of the concepts and operations needed in most instances of educational research and is a fine reference volume.

2. Thorndike, Robert L. and Hagen, Elizabeth. *Measurement and Evaluation in Psychology and Education*. Chapman and Hall, Ltd., London, 1955.

A sound and comprehensive treatment of measurement in education. The illustrations are numerous and suggestions of a practical nature about test construction are given. Theory and basic concepts are well developed.

D. EDUCATIONAL LEADERSHIP

1. Mackenzie, Gordon N. and Corey, Stephen M. *Instructional Leadership*. Bureau of Publications, Teachers College, Columbia University, New York, 1954.

This book will be of especial interest to principals, headmasters and inspectors. In it are discussed various approaches to bringing about improvements in teachers. Research and experimentation as a way of facilitating change are emphasized. The concept of cooperative problem solving as it applies to school administration is developed at some length.

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